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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Chemistry in Agriculture

PERHAPS no better indication is needed of the intensive manner in which chemistry is being organised for the study of problems involved in agriculture than the fact that no fewer than nine official research stations are now established in this country for the purpose of dealing with every phase of agricultural technology. From a small start made some thirty odd years ago the present comprehensive organisation has grown, and not the least satisfactory feature of the state of affairs as it now stands is the enthusiasm with which the farmer has co-operated with the scientist and shown his appreciation of the value of research and its application to soil problems. The few and isolated experiments of by-gone years have now become an established and almost universal practice, and one hesitates to think what the position of the farmer as well as of the country as a whole would have been to-day had the productive capacity of his land never attracted the attention of the scientist and chemical manufacturer.

As we learned to our cost in the early stages of the late war, our actual, as against our potential, capacity for food production was not exactly a credit to us, and the inference to be drawn was that the consumption of fertilisers was, and still is, well below what it should be. It has been shown that in the United Kingdom the actual consumption of pure nitrogen is in the neighbourhood of 4·5 lb. per acre, whereas the possible consumption is 12 lb. per acre. In Germany the actual consumption is no less than 10·3 lb. per acre, so that, comparatively, the margin between what is used and what might be used in this country is enormous. Figures such as these are sufficient to show what room there is for active propaganda among the farmers, and there can be no doubt that the admirable work which is being carried on by such organisations as the British Sulphate of Ammonia Federation and the Chilean Nitrate Development Committee is steadily reducing the margin between actual and potential consumption.

It is not only necessary to appreciate the importance of applying fertilisers. The consumer himself must understand the best and most economical method to suit his own particular case, or he must know where to obtain reliable information on the problems with which he is confronted. In the main, the farmer is concerned in the ways and means of applying four necessary substances, namely, potash, phosphoric acid, lime, and nitrogen, which are most commonly found to be deficient in soils. Lime *per se* is not a plant food; but its presence is an essential contributory factor in that it precludes the accumulation of soil acids, renders the soil more friable and easy to work, and makes available for the plant's use the insoluble reserves of nitrogen and potash.

The technical and commercial aspects of most of these problems are discussed by various authorities in this issue. The article by Mr. E. Holmes, B.Sc., of Birmingham University, on "Some chemical aspects of agriculture," supplies as complete a survey of this vast subject as could be compressed within the available space. The composition and characteristics of soils, the application of artificial fertilisers for the replacement of exhausted fertility or the correction of excess or deficiency in essential properties, the effects of bacterial activity, and so forth—all these matters are dealt with in turn. In addition, the use of high-grade chemicals for the destruction of insects and fungoid pests and the preparation of feeding stuffs, which have come so much into use in recent years, are discussed. The present position of the nitrogenous fertiliser industry is dealt with by Dr. Sidney Williamson, one of our first authorities on the subject. The invaluable part which lime plays in the right treatment of soils is considered independently by two correspondents, who not only point out its physical, chemical, and bacteriological effects, but indicate the advantages of the use

of fine qualities. The fertilising effects of potash are examined by Mr. G. A. Cowie, well known as a specialist in this field, while the past year's developments in the French potash mines are described by a writer intimately familiar with the subject. Notes are published respecting the plant and operations of what is known as the Butters Nitrate Process, to which reference has frequently been made of late. Finally we have some notes on the application of well-known special chemical preparations to the diseases of fruit trees, etc.

This collection of articles is sufficient proof of the great part which chemistry plays throughout the whole industry of agriculture—an industry which itself constitutes nature's largest laboratory—the enormous benefits which have resulted in the raising of crops and stock, and the large commercial and industrial operations which the application of chemical science to agriculture involves.

Chemical Salesmanship

Of all the factors that go to secure success in business none exceeds in importance that of good salesmanship. The function of manufacture is to produce articles which the public or some particular section of the public need. It is the art of the true salesman to link up the producing and the purchasing ends by proving to the buying class what they already lack, and showing how some particular product meets the need. The manufacturer's product requires an intelligent and resourceful interpreter, and the purchaser often needs in his own interest to be educated as to his own requirements. This is the art of salesmanship. Without it the best products may never reach the markets awaiting them. With it an indifferent product may beat others of higher merit. Good salesmanship, therefore, is one of the indispensable conditions of good business.

Looking around the great group of industries comprehended in the term "chemical industry," can it be said that there is any definite science or philosophy of salesmanship cultivated among chemists? Is salesmanship looked forward to as one of the careers open to the young chemist? If a young chemist has any feeling for that side of the industry, is there any body to which he can turn for the necessary training and directional instruction? We know of none. The larger and better-organised firms, no doubt, have their own domestic methods of training for their various departments. Public provision is entirely absent. There is no standard of recognised qualification, no course of definite training. Numerous as our organised societies are, none has done anything to create a definite vocation of salesmanship, or to make young chemists realise the profitable field it represents. It is time some of our societies set about revising their policies and programmes, and bringing them into closer contact with realities.

This question is raised now for two reasons. The first is that on the manufacturing side—whether we take plant, heavy chemicals, fine chemicals or dyestuffs—we believe British chemical industry to be making real advances, and with improvement in production we want corresponding improvement in the presentation and sale of our products. The second is that at present there is an excess of young chemists awaiting openings, and here is one field in which numbers of them could be well employed. The young chemist, in our opinion, has no worse or more stupid adviser than the person who seeks to confine his outlook to the laboratory. That bright-minded person who announced with real pride the other day that he never read the trade press would ornament any museum. The laboratory, it is true, is the foundation of progress; there will always be men who turn to it and will remain in it as naturally as the saint turns to the cloister or the worldling to politics. Our point is that, for chemists even of the very highest training, the laboratory is not the sole outlet. Some of the finest openings for service lie in executive or directional posts (in which high scientific qualifications are often as necessary as commercial gifts) and in works management. To these may safely be added commercial or technical salesmanship. Yet among our numerous associations is there one capable of making a move towards improvement?

The question is asked in all seriousness, because other nations are moving, if we are not. Germany has long ranked chemical salesmanship among the branches in which definite training is required. America is taking definite action in the same direction. The Salesmen's Association of the American Chemical Industry has just initiated the first course of lectures in chemistry for chemical salesmen at the College of New York. Between 25 and 30 of the leading American chemical manufacturing firms are represented in the movement, and prizes are offered for the best three essays at the close of the course on "The value of chemical training to a salesman." The Philadelphia Chemical Club is arranging a similar course for salesmen at the University of Philadelphia. If the governing bodies of our chemical associations lack the imagination to see what is going on elsewhere, cannot a few of our constructive minds join together and give a real lead in a matter of this sort?

Conditions in the Coal Industry

It has frequently been said, and not without some truth, that the coal industry in this country is the barometer of trade in general. If this axiom be accepted it must be admitted that the recently published Report of the Advisory Committee for Coal and the Coal Industry does not make altogether encouraging reading just at the time when we are confidently expecting, and almost beginning to feel, a really tangible trade revival. The task of revivifying the coal industry and imbuing it with some of its pre-war prosperity is by no means an easy one; for if the ball is to be set rolling in the desired direction it is essential that pit-head prices should come down. The Committee expresses the opinion, however, that with the cost of production standing at its present level it would be impossible to cut prevailing prices and at the same time give an adequate return to coal-owners and coal-miners. The situation, in fact, is grave, and the only possible way out of the *impasse* is to be found in promoting an increased demand for coal and thus stimulating fuller employment at the pits. Mainly, it is the industrial demand which must be looked to for effecting this reduction in the cost of production; but

the Committee's implication in this respect might, perhaps, be characterised as a little naïve, for surely the forerunner of increased industrial demand must be a reduction in coal prices such as will enable industrial coal consumers to turn out their products at competitive prices, and not *vice versa*.

Whatever the pit-head prices may be, they represent only part of the cost with which the consumer is saddled, for by the time coal reaches the point of consumption it has, in addition, to bear the cost of transport. In this latter direction there would certainly seem to be room for considerable alleviation, for, as the Committee states, transport forms a very substantial portion of the total cost of coal to the consumer, and, so far as the bulk of industrial coal is concerned, the opinion is expressed that further reduction in rates must be effected as soon as possible if the contribution which the coal industry has already made towards the revival of trade generally is to have full effect. There undoubtedly prevails a suspicious feeling that intervening agencies between the pit and the consumer are reaping more than their due reward—a suspicion which does not tend to be dissipated when consideration is given to the disparity in the two prices. The local distributors lay the blame on the shoulders of the railways, and if the railways are the chief transgressors one might ask whether the recent grouping, or amalgation, arrangements of all the railway undertakings in this country is likely to be conducive to a lowering of transport rates? On the face of it it would seem that grouping implies the strengthening of a monopoly, and monopolies are not exactly amenable to pressure. One instructive point which emerges from the Report is that household coal shows, as compared with pre-war days, the greatest percentage increase in cost. Some of our idealists might be prepared to suggest that in reality this is a blessing in disguise, for it may eventually drive the open-grate miscreant to the use of gas or electricity—and so in course of time we should arrive at that smokeless Elysium where there would be neither need nor opportunity for our learned professors to shed tears over the "pundits who may now be seen solemnly enumerating the soot particles, and duly recording the average arrived at against the fog demon."

The Almighty Dollar

In connection with the recent resignation by Dr. S. W. Stratton of the directorship of the Bureau of Standards, Washington, and his acceptance of the presidency of the Massachusetts Institute of Technology, attention was drawn to the temptation to look for chemical openings in industry rather than in the Government service owing to the much higher salaries paid. Since our comments appeared the situation has developed. Although the position vacated by Dr. Stratton is one of the most important of the kind at the disposal of the U.S.A. Government, no suitable successor has yet been found. Mr. Hoover, the secretary of the Department of Commerce, makes no concealment of the cause. Owing, he says, to the fact that industry is making much more extensive use of research laboratories, the supply of physicists is now below the demand. Salaries which were formerly from $3,500 to $5,000 have now risen to anything between $10,000 and $20,000. Dr. Stratton, in talking with us shortly before his resignation took effect, made no concealment that the change had a financial aspect; at the same time we fancy the opportunity of service offered by the Massachusetts Institute was an equally important factor. For the moment no permanent appointment is to be made, but Dr. F. C. Brown, assistant to Dr. Stratton, has been appointed acting director. It is quite possible that the circumstances which have led to this temporary appointment may lead later to its permanent confirmation.

Points from Our News Pages

Specially written articles are published dealing with various aspects of agricultural chemistry and fertilisers (pp. 80–91).

Dr. W. E. Gibbs contributes a further article on the problem of dust explosions in industry (p. 92).

Abstracts are given of two interesting papers read before the Manchester Section of the Society of Dyers and Colourists (p. 95).

The less common metals occurring in the British Empire were discussed by Professor G. T. Morgan at Birmingham on Monday (p. 96).

According to our London Market Report trade has been quite active this week, a fair volume of business has been transacted, and prices, already firm, show an upward tendency (p. 104)..

According to our Scottish Market Report, business continues fairly satisfactory, values on the whole being steady (p. 107).

The Calendar

Jan 27	The West Yorkshire Metallurgical Society: Symposium of papers on Casting of Metals.	City Museum, Leeds.
30	Hull Chemical and Engineering Society: "A Review of the Present Position of Liquid Fuel." C. H. Hardy. 7.30 p.m.	Hull Photographic Society's Rooms, Grey Street.
31	Royal Society of Arts: "The Relation between Chemical Constitution and Antiseptic Action in the Coal Tar Dyes." T. H. Fairbrother and A. Renshaw. 8 p.m.	John Street, Adelphi London, W.
Feb. 1	The Chemical Society: Ordinary Scientific Meeting. 8 p.m.	Burlington House, Piccadilly W.1.
1	Society of Chemical Industry (Bristol Section). Joint Meeting with the Institute of Chemistry: "The Necessity for a Change in the Milk Standard." E. Russell. 7 30 p.m.	The University, Woodland Road.
2	Royal Institution of Great Britain: "Fact and Phantasy in Industrial Science." C. F. Cross. 9 p.m.	Albemarle Street, Piccadilly, W.1.
2	Society of Chemical Industry. (Manchester Section): "A New Process for the Manufacture of Sodium Thiosulphate." L. Hargreaves and Dr. A. C. Dunningham. 7 p.m.	16, St. Mary's Parsonage, Manchester.
5	University of Birmingham Chemical Society: "Drugs and Poisons; the Chemistry of their Physiological Action." A. W. Burtt.	Birmingham.
7	Society of Public Analysts: Annual General Meeting. 8 p.m.	Burlington House, Piccadilly, W.1.
Feb. 19 to Mar. 2	British Industries Fair.	London and Birmingham.

Some Chemical Aspects of Agriculture

By E. Holmes, B.Sc.

THE intensive agriculture of the present day demands the application of a very wide and varied knowledge of natural science. Chemistry is required in the study and efficient use of soils, fertilisers and feeding stuffs. The basis of all agricultural resources is the soil. More as a matter of convenience than for any other reason, soils have been classified under the heads—sands, clays, silts and loams. Sand, the particles of which range from .04 to 1 m.m. in diameter, shows great resistance to weathering. Mixed with ordinary soils, it gives larger pore spaces. Some silicates behave agriculturally like sand, others decompose, particularly under the influence of superphosphate or potassium sulphate. Weathering reduces silicates to rounded particles of diameter less than .002 m.m. Substances of this nature are the constituents of clays—indeed, the agricultural chemist regards them as true clays, any larger particles being simply admixtures. Clay is essentially colloidal in the flocculated or friable state it is suitable for plant growth, while in the deflocculated condition, usually associated with soil acidity, it is practically useless.

Between the inert sands and the fine clay particles, we have the intermediate silts, conventionally expressed as particles between .002 and .04 m.m. While clay can be flocculated by means of lime, frost, or vigorous cultivation, silts resist these agents to such an extent that at the present time no adequate means are available for dealing with them.

In contact with the different soils we have a variable amount of moisture which is presumably saturated with the soluble constituents of the soil. This constitutes the nutrient solution for the plant. Its composition varies with rainfall and manuring, and cropping invariably reduces the soluble matter. The study of the physical properties of soil solutions has brought out several remarkable facts. Solutions in quartz, sand, and very light sandy loams obey approximately Raoult's dilute solution law—the freezing point varying as the concentration. In the case of ordinary soils, however, this rule does not apply—the freezing point depression increasing more rapidly than the moisture content falls off. Bouyoucos explains the discrepancy by supposing some of the soil moisture to play no part in the phenomenon of the depression of freezing point, and deducts from the total moisture a sufficient amount, which he calls "unfree water," to leave a balance of "free water" that will conform to the freezing law.

Most of the water is held in the pores of the soil by physical forces, the amount present depending on rainfall, evaporation and drainage. Mean values for soil contents are given as 9 per cent. by weight in sandy soils, 12 per cent. in loams and 27 per cent. in clays. Water supply and aeration are most important factors in plant growth and have been investigated extensively in India, under Howard. Flood irrigation on fine alluvial soils interferes with their ventilation, by rapidly disturbing the texture of the soil and by forming a compact crust impermeable to air. Over irrigation diminishes yields chiefly by suppression of aeration. At Quetta, for example, thirteen maunds of wheat were obtained with one irrigation, while only eight were obtained with three irrigations.

In Germany, research has been carried out along somewhat original lines. Salts are allowed to act on a soil which is then extracted with water and the effects on the physical properties of the soil studied. Salts of the univalent metals—particularly sodium salts—damage the texture of the soil, while those of the bivalent metals do not. In these cases, however, the effects are not so much those of the actual compounds as the results of subsequent hydrolysis after the salts are washed out.

Composition of Soils

Soil possesses many of the attributes of a colloid, such as adsorption, retention of water and so on, to such an extent as to suggest that its particles are coated with a "gel" which might well be formed of silica, alumina or iron oxide. In soils where water is very near the surface layers of rock 5 to 7 cms. thick sometimes occur. They are known as pans and are formed by precipitation of colloidal matter at depths of six inches to a foot beneath the surface, the action being to restrict root growth and water percolation. These should not be confused, however, with the plough sole, which is caused by persistent ploughing to the same depth, the weight of the plough pressing on the bottom of the furrow causing a certain amount of consolidation. Pans and plough soles are broken by occasional deep cultivation or subsoiling.

The ultimate composition of normal soils is approximately the same as that of the whole of the earth's crust—the carbon as organic matter being rather higher. The soluble constituents are subject to the greatest fluctuation, chiefly due to rainfall and drainage. As much as 8–10 cwt. of chalk have been shown to be washed from an acre in a year. Nitrates also tend to be washed out, and leave the land impoverished. On the other hand, a dry soil accumulates until it becomes barren through excess. Thus nitrogenous manures are ineffective on the cotton crops of Egypt, since nitrogen is accumulative under the natural dry conditions. Nitrate formation in a poor, unmanured soil—usually measured by the amount washed out in drainage water—proceeds at a very slowly diminishing rate for an almost indefinite period—more than fifty years, according to Rothamsted experience. The simplest explanation is that the nitrate formed in any one year is not wholly available for the plant or for loss by drainage, a portion may be supposed to be taken up at once by the organisms present and converted into protein which subsequently nitrifies. Thus the whole of the nitrate can never be exhausted and the process may be expressed by an asymptotic curve. In this connection, Burd, from exhaustive soil and crop analyses, found that there was never less than nine days' supply of nitrate and 24 days' supply of phosphate, even in a poor soil. This is surprising, since it is notorious that addition of nitrate and phosphate does increase plant growth. The only way out of the difficulty is that plants in infertile or poor soils cannot take up the whole of the potentially soluble matter, the phenomenon being regarded as a balanced reaction.

Since nitrates are very liable to be washed out of a soil, the advantages are wholly in favour of a dry autumn and a cold dry winter, which conserve the supply. This explains the recent calculation of Sir W. N. Shaw that every inch of rainfall during the autumn months—September, October and November—lowers the yield of wheat during the next season in the eastern counties by 2·2 bushels per acre from an ideal standard of 46 bushels per acre. The loss of nitrate from sand is low, since the nitrate is low, from clays low because percolation is slow; but it is high from good loams. The loss of nitrate may be prevented by sowing "catch crops" in autumn to be ploughed in or folded over before the spring sowings. It may be made good by spring dressings of quick-acting nitrogenous manures, soot or ammonium sulphate, if the surface is spongy, or sodium nitrate if the soil can be brought to a reasonable tilth. Where a soil becomes water-logged the percentage of oxygen falls off in the remaining air.

The property of adsorption is usually attributed to the colloidal nature of the soil. The chemical school, chiefly in Russia, however, ascribe it to the supposed presence of zeolites or particularly active minerals.

Another property claimed as colloidal is the so-called acidity of some soils. It is assumed that they have the power of preferential absorption, taking up basic ions more readily than the acidic ions, therefore changing the colour of the indicator. Again, the chemical school disagrees and maintains the presence of substances of acid reaction. They are faced immediately with the difficulty that no undeniable acid has ever been isolated except in minute quantities. Various methods have been used to show their presence :—

1. The hydrogen ion concentration,
2. The rate of inversion of sucrose, and
3. The liberation of iodine from KI or KIO_3.

These fail, however, to agree among themselves and show no connection with the litmus test, or the amount of lime or calcium bicarbonate necessary to leave excess lime in the soil. It is doubtful whether a definite PH value can be assigned to soil solutions. The U.S. method for PH assumes that the hydrogen ion is the only agent capable of inverting sucrose. Another explanation is that the acidity arises from the hydrolysis of salts of iron and aluminium formed by addition

of other substances to the soil. Fertilising with ammonium and potassium sulphates increases the value of acidity, the former being the more potent. Superphosphate has little, if any, effect.

Whatever the cause, acidity can be remedied by liming. This is important in practice, since acid soils are infertile to nearly all crops except potatoes, whilst after neutralisation they become quite productive.

It has always been supposed that green plants required only about a dozen elements for perfect nutrition—

C H O N P S K
Ca Mg Na Fe

Mazé, during the past few years, has been adding to this list, and claims as a result of recent investigations that traces of the following are necessary :—

B F I Cl Si Al Mn Zn

On the other hand, he found no necessity for organic substances, although some of them were helpful. The traces required must be very small, since it is common experience at Rothamsted to obtain copious and normal growth of barley in water cultures containing the purest obtainable salts of the conventional nutritive elements.

Probably the most complicated constituent of soils is the organic matter from plant and animal residues. The recent plant material comes under two headings :—

1. Undecomposed roots and stubble, still retaining some structure of the plant, and
2. The partly decomposed material, dark brown or black in colour which has fallen entirely to powder and become completely intermingled with the soil ; it is then known as " humus."

The former is very useful in heavy farm soils since it tends to keep the soil open for irrigation. Humus is helpful in a variety of ways. Its dark colour facilities warming in spring —except in chalky soils—it increases the holding capacity for water, and it helps in the production of a fine tilth and a good seed bed. It is notable that the black soils were always taken up for cultivation first, in the Fen districts, in the prairies of Western Canada, and in the black earth, or Tchernozen, of Russia. Continued cropping of these lands by wheat, particularly in the latter districts, has caused loss of organic material. Snyder found in Minnesota that 50 per cent. of the nitrogen, chiefly as organic nitrogen, was lost after twenty years, whilst Schutt in Saskatchewan found 30 per cent. to be lost over an equal period. Under these conditions the soils become impoverished and if they contain clay tend to become difficult and expensive to work. Since transport difficulties have, up to the present, prevented the application of artificials, such soils tend to be thrown out of cultivation and go derelict.

The soluble portion of humus usually contains 50-57 per cent. C, 35 per cent. O_2, and 3-8 per cent. N. The old idea was that it was composed of a mixture of acids such as humic, ulmic, crenic, and apocrenic acids—per cents. being quoted. At the present time this has been discarded and no satisfactory analysis proposed.

All organic matter in the soil is perpetually undergoing decomposition, ultimately to Co_2, H_2O, NH_3 and various inorganic salts. Since a variety of agencies, such as bacteria moulds, and enzymes, are at work, and all changes occur at low temperatures, there are numerous intermediate products. The organic substances added include carbohydrates, such as sugar, starch and cellulose, the pentosans, gums, proteins, nucleo-proteins, fats and waxes. Soil constituents are being extended yearly. For example, in 1918 benzoic acid and p. hydroxy benzoic acid were added to the list, the latter being in distinctly appreciable amount—twenty-two parts per million.

Fixation of Nitrogen

Nitrogen in the soil never remains as part of the same molecule for very long. In some degradation processes proteins break down to give ammonia, while leguminous plants build up protein from gaseous N. The energy required by the bacteria to bring about these processes is supplied by decomposable carbohydrates. When plant residues are added to soil, fixation has been observed to the extent of 9 mg. per gm. of substance added—even when the residues were not from leguminous plants. The conditions required are suitability of temperature, the presence of phosphates and calcium or magnesium carbonate. The addition of sodium nitrate increases the numbers of ammonifying bacteria, but in normal soils it also increases the amount of decomposition of added protein to gaseous nitrogen. Thus the beneficial effect of adding steadily increasing quantities of sodium nitrate shows a maximum.

Under our climatic conditions, nitrates do not have a chance to persist long—either they are washed out or used by plants. As soon, however, as the stock is depleted, nitrification commences and there appears to be no limit to the amount of nitrate a soil can yield. One Rothamsted plot has been cropped with wheat since 1843 and has had no manure since 1839, yet it still goes on yielding nitrate to such an extent that in September, 1913 it contained 35 lb. of nitrogen as nitrate in the top layer of eighteen inches, equivalent to 210 lb. of sodium nitrate per acre.

Fixation goes on vigorously during the growth of clover, trifolium, lucerne, sainfoin, vetches, peas and beans, and proceeds to a limit, particularly in grass soils since they usually contain more nitrogen than other soils. Land in sod gains nitrogen, a gain absolute—land in fallow gains nitrate, only a change in form of nitrogen. It is remarkable that the soja bean grows and fixes nitrogen through nodule bacteria even in the presence of soil acidity, the general conclusion being that non-leguminous plants, those capable of assimilating ammonia, can flourish in acid soils, those depending on nitrates cannot. Under conditions where land is water-logged, nitrates decompose to give nitrites and subsequently gaseous nitrogen. This goes forward very slowly in cold weather, probably rarely under British agricultural conditions, but in the wet rice fields of the East it takes place rapidly. Therefore nitrites are never used as manures.

Alkali Soils

At the Utah experimental station, where alkali soils present troublesome problems, Greaves and his colleagues have been studying the effect of inorganic salts on bacterial activity. Salts commonly occurring in alkali soils are sodium sulphate, sodium carbonate and calcium chloride, and since these are very toxic to bacteria it appears possible that part of the unsuitability of alkali soils for plant growth may be due to depression of essential nitrate production processes. Common salt up to a concentration of .01 per cent. acts as a stimulant to the bacteria, but above this it becomes toxic.

The only known organism capable of decomposing cellulose in the soil has been examined at Rothamsted.* Under ærobic conditions it works with comparative ease. It more closely resembles the Spirochaets than the bacteria, and is therefore named Spirochaeta cytophaga. Its vegetative growth takes the form of a sinuous, filamentous cell, which is very flexible but only feebly mobile, apparently not possessing flagellæ. This organism requires combined nitrogen, which it prefers in the form of nitrates, ammoniun salts, amides or amino acids. Peptone serves in dilute solution, but a toxic limit is soon reached, whilst the conventional nutrients, gelatin and agar, are both unsuitable. The carbon requirements of the organism are met only by the cellulose ; sugars, alcohols and salts of organic acids are ineffective and some definitely toxic. Given a suitable simple nitrogen compound and its other requirements, the organism energetically decomposes cellulose, producing among other things a pigment somewhat like carotin, a mucilage and small quantities of volatile acids. It has been shown that these products are suitable for the needs of Azotobacter and allow of the assimilation of gaseous nitrogen.

Partial Sterilisation

In the last two decades increased attention has been given to partial sterilisation of soils—in other words, the killing off of harmful bacteria whilst leaving the useful forms. It is found that useful organisms are harder to kill than the less useful forms, so that a hard winter has a beneficial effect on the micro-organic population of the soil. Steam and dry heat have been applied, but they are usually expensive, and inconvenient on a large scale. At the present time a variety of chemical " sterilizers " are available, usually in the form of some kind of naphthalene or CS_2 preparation. They have the added advantage of destroying or removing a number of insect pests.

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* H. B. Hutchinson and J. Clayton, *Journ. Agric. Sci.*, 1919, 9,143.

Previous to 1840 the only concentrated manure was bone, which then formed an article of international commerce. Following the guano period, other artificials began to be introduced, until in 1875, when the guano supplies failed to meet requirements, sodium nitrate, superphosphated and ammonium sulphate came into use. The basic slag industry started about 1880.

Nitrates are now available in four forms, as sodium, potassium, calcium and, more recently, as ammonium nitrate, the first being the most common.

It occurs as the crude Caliché in the rainless regions of Tarapaca and Antofagasta in the north of Chili, and, despite the fact that before the war the annual consumption was two and a half million tons, there still appears to be a vast supply for the future. There is no indication as to how the nitrate came to accumulate in these districts, although there is little doubt but that they were once under water. The crude nitrate is excavated by a process of trenching; it is crushed, purified by recrystallisation, and put into bags for the market. It is usual to guarantee 95 % purity for agricultural purposes.

Sodium nitrate is a very quick acting manure, and is often applied in cases of emergency when young plants are suffering from attacks of pests, or in cold, wet weather. In ordinary practice it is used as a top dressing of 1-10 cwt. per acre. All English crops show an increase upon application, but in parts of Australia and New Zealand phosphates are the limiting factor, and the addition of nitrates shows no benefit. Sodium nitrate gives a rich green colour to vegetation and increases the size of the leaf. It may so enlarge cereal crops that the straw fails to support the weight of the head, in which case the crop becomes "laid." In excess, it tends to thin the cell wall, making plants more susceptible to fungoid pests—and at the same time affecting the sap so that fungi develop more rapidly. It shows an interesting reaction in the soil. Sodium nitrate is not taken into the plant, but breaks down, nitrate going to the plant and the sodium remaining chiefly as bicarbonate—this reacts with potassium compounds in the soil to give an amount of potash available for the plant. This is beneficial, but, at the same time, the bicarbonate acts on clays, converting them into the deflocculated or sticky condition, being very detrimental to heavy soils. The remedy is a dressing with lime, or the addition of ammonium sulphate to the nitrate.

Potassium nitrate is dearer than the equivalent mixture of sodium nitrate and potassium sulphate, and is not used in this country. But being less bulky, it finds application in the Canary Islands, where valuable crops are raised and where freights are high.

The calcium nitrate industry was started by Sir William Crookes in 1898, and is carried on at Notodden, in Norway, and Niagara, where abundant cheap water power is available. The first product obtained was pasty $Ca(NO_3)_2$, but now a product is obtainable as a stable basic compound containing approximately 13 per cent. nitrogen. It resembles sodium nitrate in action, without the disadvantage of deflocculating clays.

Ammonium sulphate is a valuable by-product of the coal gas industry—so much so that in 1913 it was manufactured to the extent of a million and a quarter tons, three times the amount available ten years previously. The largest prospective supply, however, is from the Haber electrical process. It usually contains a little free acid, but in the trade it is considered neutral if it contains less than ·025 per cent. acid.

Ammonium nitrate contains 35 per cent. nitrogen, but unfortunately it is deliquescent and highly soluble. Some crystalline modifications can now be used.

Calcium cyanamide, "Nitrolim" or "Kalkstickstoff," was first made at Piano d'Orte, in Italy, but has since been manufactured at Odda, in Norway, Alba, in Sweden, and at Niagara. It is insoluble in water, and is not itself a plant nutrient, but it easily decomposes in the soil to chalk and ammonia, and is assimilated in the usual way. It is not quite so quick acting as ammonium sulphate or sodium nitrate, and is therefore applied when the seeds are sown. Special precautions are taken at the factory to free it from calcium carbide, and it is sent out in a finely divided state. In this condition it is objectionable to handle, labourers getting it into their mouths, eyes and noses, where it causes inflammation. Many attempts have been made to granulate it, the usual difficulty being that in the presence of alkalis, Calcium cyanamide polymerises to $(Ca\ CN_2)_2$, Calcium dicyanodiamide, which is poisonous to plants and to nitrifying bacteria.

From a recent number of the *Journal of the Society of Chemical Industry* a method appears to have met with success, in which the nitrolim is worked up with sulphite cellulose pitch, a waste product of paper manufacture. The pulverised nitrolim and sulphite cellulose pitch are mixed, and cellulose waste lye is added in one or more operations until a plastic mass is obtained. This is then heated on rippling rolls or plates until dry. The product is free from dust, and it is claimed that short fibred refuse from cellulose and paper manufacture may be added to increase the fertilising value of the mass.

Pure $Ca\ CN_2$ contains 35 per cent. nitrogen, but the commercial product usually contains quantities of lime and graphite, bringing the nitrogen content down to 18-20 per cent. Under certain soil conditions, it has been found that calcium cyanamide can give cyanamide which polymerises to give dicyanodiamidine, which is extremely toxic to plant growth.

Sources of Phosphates

There are three main sources of phosphates—bones, superphosphate and basic slag. In modern practice, bones are sent to the factory, placed upon perforated bands and sorted, the clean shank bones are picked out for cutlery, the hard bones for glue, and the remainder crushed. The separate batches are steamed at low pressure (15-20 lb.) to remove fat—nowadays a valuable commercial product. In some works the bones are degreased with benzene, and since it is more efficient than steam the resulting meal is richer in phosphate and nitrogen.

Bone meal usually acts best on soil rich in humus, or soils lacking in lime. It is not very satisfactory on calcarious soils.

In 1842, Lawes patented his process for manufacturing superphosphate, thus laying the foundation of the enormous artificial fertiliser industry of the present day. The principle of the process is simple—rock phosphates, themselves of no great fertilising value in this country, are treated with sulphuric to convert the normal calcium phosphate to the more soluble $Ca\ (H_2PO_4)_2$. The superphosphate is actually a mixture of calcium sulphate, mono calcium phosphate, and some free phosphoric acid. The gypsum is not extracted since it does no harm, and has itself some small fertilising value. It also helps to keep the actual phosphate dry. Ten million tons were the actual production before the war—the rock phosphate coming chiefly from North America.

It has been found convenient to standardise the various grades of superphosphate and sell them on a definite basis. The amount of soluble phosphate is determined as P_2O_5, and the figure calculated as normal calcium phosphate. Thus the ordinary grade contains 12 per cent. P_2O_5, soluble in water, the figure being multiplied by 2·18 to give $Ca_3\ (PO_4)_2$. Both figures are conventional in that superphosphate consists neither of P_2O_5 or $Ca_3\ (PO_4)_2$. Superphosphates favour root development in early stages of plant growth and hasten maturity. It is essential for swedes and turnips, and gives good returns even when the soil seems rich in phosphate. It induces hard growth in plants that are becoming too sappy. Although it is easily soluble in water, it is rapidly precipitated in soil, only very small quantities finding their way into drainage water.

Basic Slag

Basic slag was formerly known as basic cinder or Thomas's phosphate powder. The older or Bessemer process was begun in 1879. Molten pig iron is run into pear-shaped converters and air blown through it. Since the high temperature is maintained chiefly by combustion of the phosphorus and silica contained in the pig iron itself, it is to the advantage of the steel maker to have sufficient phosphorus present. If the ore does not contain enough for the purpose, foreign ores, rich in phosphorus, or Belgian phosphates, are added in the blast furnace. All the phosphorus goes into the pig iron, and when this is blown in the converter a slag is obtained containing phosphorus equivalent to 40 per cent. of normal calcium phosphate.

The more recent method is the open hearth process, and, being more convenient to the steel maker, it seems likely to displace the Bessemer process. Unfortunately for the agriculturist it does not produce so useful a slag. The pig iron

is heated in a furnace by superheated producer gas, and since the heat is independent of the phosphorus content, no phosphate material is added. The process gives a slag containing only 7-14 per cent. P_2O_5, besides being less readily soluble in 2 per cent. citric acid. When the growing season is long, the lower grades of slag have proved more effective than their low citric acid solubility would appear to indicate.

The value of basic slag was recognised by Wrightson in 1884, and in 1885 Paul Wagner began systematic research at Darmstadt. It gradually came into use, and within four or five years could profitably be adulterated with mineral phosphates, to detect which Wagner devised the well known citric acid test.

Basic slag is sometimes said to contain 22–44 per cent. of normal calcium phosphate. This is incorrect, the actual nature of the compound not being known accurately, but it is probably a complex silico phosphate. Morrison has shown that it is a compound of the type $(MO)_5\ M^1O,\ SiO_2,\ P_2O_5$ and actually found M=Ca ; M^1=Fe. It usually contains 2 per cent. of lime, which gives a distinct alkaline reaction.

Slag is not soluble in pure water, but it dissolves in the presence of CO_2, particularly if it is in a state of fine subdivision. Usually 80 per cent. is guaranteed to pass through a sieve with a hundred meshes to the linear inch.

Basic slag gives remarkable results on clay grass lands, its action being to stimulate the white clover, which then increases the nitrogenous content of the soil. It is valuable on arable land for swedes and turnips wherever there is any tendency to "finger and toe." Furthermore, it increases the feeding value of roots.

From time to time other attempts have been made to utilise natural phosphates by converting them into more soluble compounds. Probably the most interesting of the later developments are due to Wilbergh and Palmaer, both of the Polytechnic Institute of Stockholm. Large quantities of impure natural phosphates are obtained from the north of Sweden, which Wilbergh attempted to utilise by fusing with sodium carbonate. The product was good, but too costly. Palmaer adopted an electrolytic method, and acted on the phosphates with the acid solution collecting round the anode during the electrolysis of sodium chlorate, then precipating with the alkaline solution from the cathode. Finally, the solid was filtered off, leaving the chlorate solution to be used for further electrolyses. The material is found to be quite satisfactory.

Blast Furnace Flue Dust

By the old system of agriculture, in which the grain was sold, and straw, in the form of manure, returned to the soil, the tendency was to conserve the potash and exhaust the phosphate, and so reduce to a minimum the need for buying potash. But with the advent of more varied cropping to include the growth of potash-needing crops, like mangolds and potatoes, and of sugar-beet on the Continent, there has arisen the necessity for applying potash to the soil. From the "sixties" until the war all potash came from the Stassfurt deposits in Prussia, chiefly in the form of Kainit (K_2SO_4, Mg So_4, Mg Cl_2 $6H_2O$) and Carnallite (KCl, Mg. Cl_2, $6H_2O$). The demand was so great that before the war ten million tons of crude salt, equivalent to a million tons of K_2O were produced annually, mainly for agricultural purposes. The Alsatian deposits, occurring in the plains north of Mulhause, consist mainly of Sylvinite, crude KCl, and are now being worked extensively, Sylvinite contains 20–22 per cent. of K_2O as compared with the 12–13 per cent. in German Kainit.

In this country, blast furnace flue dust has been exploited to some extent, grades containing anything from 3–15 per cent. K_2O being obtained. The potash occurs mainly as sulphate and silicate. Some samples, however, contain cyanides and sulpho-cyanides, which would be harmful in any appreciable quantity.

The usual dressing of potash is 2 cwt, of KCl or K_2SO_4 for potatoes, or 4 cwt. Kainit for mangolds. It gives better results on grass lands, especially on thin soils, and on leguminous crops. Light sandy and moorland soils respond considerably to dressings of potash, and since these two types of soil are frequent in North Germany, the German consumption of potash is explained. In 1913, Germany produced nearly twice the amount of wheat per hectare, as compared with France—but she used 18 times the amount of potash per hectare over the same period.

Potash has three effects. It facilitates the production and translocation of sugars and starches from the leaf, hence its value for sugar and starch making crops like sugar-beet, mangolds and potatoes. It stiffens the straw of cereal crops, and of the grass tribe generally, and counteracts rankness in growth. Furthermore, it enables plants to withstand adverse conditions of soil, climate and disease.

Dressings of potash, and particularly of Kainit, have occasionally reduced crops, apparently because inter-action with chalk in the soil gives rise to potassium carbonate, which has a bad effect on soil texture.

Destruction of Pests

Besides the more or less crude mixtures of chemicals so far discussed, a number of high-grade chemicals are used for specific purposes in agriculture, more particularly in the destruction of insects and fungoid pests.

Naphthalene and CS_2 preparations, used as partial soil sterilisers, are useful in the removal of the following :—

1. The turnip gall weevil, whose larva is so destructive to the young roots of turnips and cabbages.
2. Wire worms, the larvæ of Click beetles or Shipjacks. Since these are general eaters, and live in the wireworm state for three to five years, their work of destruction is extensive.
3. The leather jacket, or larvæ of the crane fly, which is particularly destructive to grass.

The cabbage root fly, carrot fly, mangold fly, and onion fly are all dealt with in the same manner.

Pests such as the umber moth and the mottled umber moth are best removed by putting greasebands on the trees affected, in October, and by summer spraying with lead arsenate. Coddling and magpie moths are treated similarly, while other caterpillar pests are treated with nicotine and paraffin soft soap emulsions. In the case of Red Spiders and White or Snow Fly pests in glass houses, it is best to fumigate with HCN.

Fungoid growths, like apple scab or "black spot," are best treated with lime sulphur, made by boiling flowers of sulphur with milk of lime ; or, if it is not too near market time, to spray with lead arsenate.

Smut and bunt in wheat and barley are usually treated by "pickling" the seed in 10 per cent. $CuSO_4$. Since, however, this causes damage to the germinating power of the seed, a solution of one pint of 40 per cent. formaldehyde in 40 gallons of water is to be preferred. This solution controls smut entirely.

Potatoes are protected from blight, "Phytoppthora Infectans," by spraying the haulms and leaves with Bordeaux mixture, a basic copper hydroxide, or with Burgundy mixture, a basic copper carbonate. The spraying is purely preventative ; once the brown spots appear the plant is ruined.

Prepared Feeding Stuffs

In recent years prepared feeding stuffs have become increasingly popular with stock farmers, not only for their actual feeding value, but also for their indirect manurial value. Since 50 per cent. of the total food, 75 per cent. of the nitrogen, and 90 per cent. of the phosphate and potash, are voided, the feeding of fat stock is a convenient method for soil enrichment.

A variety of cakes are now on the market. The mode of preparation is much the same in the different cases. The seeds or kernels are sun-dried before shipment to the factories, where they are stored in huge silos. They are then crushed, part of the oil being abstracted during the process. On the way to the crushers, and again when proceeding to the pressure, the material, which is invariably transported by endless bands, passes under magnets which extract any iron or steel which may have crept in during preliminary handling. The greater portion of the remaining oil is then expressed by hydraulic presses, and the residual meal pressed into slabs and then baked.

A cattle food of increasing popularity is dried brewers' grains derived from malted barley. It shows a very satisfactory analysis, something like 20 per cent. albuminoids, 43 per cent. of digestible carbohydrates, and a good oil content.

The most expensive constituent of cattle foods is the protein. Unfortunately, when the farmer buys goods on the basis of so much per cent. of protein, he has only a rough indication of what the food is going to be worth to his stock. Protein, as such, is of no use to the animal—it must first be split up by the digestive juices to give amino acids which

are to be conveyed to different parts of the body and there built up into the protein necessary for flesh and tissue. If the amino acids are in the wrong proportions, it follows that some of them must be excreted, and, therefore, wasted as far as the feeding of the animal is concerned. The conclusion is, that it is the job of the research worker of the future to determine analyses of all feeding stuffs in terms of amino acids, the requirements of cattle, and then advise the farmer as to the best poportion in which to use his feeding stuffs.

The author desires to express his indebtedness to a number of publications, in particular to several by the eminent authority, Sir E. J. Russell.

The Present Position of Nitrogenous Fertilisers

By Dr. Sidney Williamson

THE position of nitrogenous fertilisers at the present time is very difficult to define, whether it is regarded from the production or the consumption point of view, for so many uncertain factors have to be taken into account. Were it not for the problems connected with the European exchanges, there is little doubt that there would be a pronounced world shortage of these fertilisers, of which the need is being increasingly felt. The soil of Central Europe is at present starving for the lack of that nitrogen, which the people are unable to buy. Long credits would be necessary and these cannot be arranged, although for most countries it would be cheaper to increase the yield of the harvest with fertilisers than to import corn, etc. Such a situation is particularly unfortunate as artificials are needed to make up for the smaller amounts of animal manure now available. In Germany alone it has been estimated that 300,000 tons of nitrate of soda would be required to replace the decreased amount of dung, due to the diminished number of domestic animals, and the poor nitrogenous value of the cattle feed, owing to the lack of imported cake, etc. Similar conditions exist throughout the greater part of Europe.

In addition to the difficulty experienced by certain countries in arranging for large supplies, the general agricultural situation is adversely affecting others. The great fall in the prices of agricultural produce has caused the individual farmer heavy losses and deprived him of his readily available capital. Many farmers have not yet bought their fertilisers for next season, and importers and wholesale merchants are holding stocks which are being slowly liquidated. If the farmers continue their present hesitating policy an unfortunate position may develop. In some countries a large demand may suddenly arise in the consuming season, which the importer may not be able to fill, owing to lack of transport or the impossibility of replacing his stock with sufficient rapidity. This is particularly so in the case of nitrate of soda, which has to make a long journey from Chile.

When considering the question of the supply and demand of nitrogenous fertilisers, only the two principal ones need be taken into serious account, viz :—Nitrate of soda and sulphate of ammonia. The supply of the latter is admittedly short, and while there are large stocks of nitrate in Chile, it is very doubtful if a sufficient supply has yet been arranged for Europe.

Nitrate of Soda

With regard to nitrate of soda, the abnormal conditions which now prevail make any definite estimate of the consumption in Europe during the year July, 1922, to June, 1923, very difficult, but it is probable that a total figure of 1,100,000 tons for Europe and Egypt is not too optimistic. Probably the Belgian, Dutch and French markets will absorb larger quantities than last season, and in Great Britain especially, should there be any marked revival of the chemical trade, a consumption of 100,000 tons should be attained.

Germany, Poland and Czecho-Slovakia are doubtful markets for large quantities owing to the unstable position of exchanges, credits, etc., and at the moment it is not possible to foresee large purchases by these countries.

The demand of the United States for nitrate is expected to be larger, probably amounting to 700,000 tons. No doubt it is being more widely employed this year in the manufacture of mixed fertilisers which are so largely used. It has also proved to be of value in producing the early maturity of the cotton plant, by which means the ravages of the boll weevil are to a large extent checked. Any means of checking this dreaded pest is welcome, as it is one of the most serious troubles which the grower has to face. The possibilities for a large consumption of nitrate in this direction are very great, and as is well known the cotton position largely influences the American fertiliser market.

The world consumption undoubtedly depends to a certain extent upon the actual price of nitrate, that is, upon its competitive price compared with other nitrogenous fertilisers. For the present season, f.o.b. or c.i.f. prices are lower than they have been for some years, though it is possible that the latter may rise slowly as the season progresses.

It is not generally recognised that from one-quarter to one-third of the nitrate consumed is due to its use for chemical and industrial purposes, and the chemical trade has been slack.

After the past period of depression, therefore, the outlook for the Chilean nitrate industry may be said to be extremely satisfactory, and with every prospect of improvement when certain unfavourable factors disappear.

Sulphate of Ammonia

The world's production of by-product sulphate of ammonia during this fertiliser year 1922–23, is estimated to be practically the same as for the previous year—viz., roughly, 1,200,000 tons. Of this amount about 300,000 tons will be produced in Great Britain.

With the exception of the British production, and occasionally that of the U.S.A., sulphate of ammonia is usually consumed in the countries of origin, where the supplies are not equal to the demand. For this reason Britain has previously exported a large proportion of her output. During the war period, when all the nitrate available was required for war purposes, and even since, sulphate of ammonia has been offered to the British farmer at favourable prices, considerably under the export value. This fact has led to a largely increased home consumption, and thus to a decrease of the exports, which are now being gradually resumed.

The uncertain agricultural outlook has again caused farmers to delay their orders for this fertiliser for the coming season, and to obviate a possible shortage in Britain in the spring, the British Sulphate of Ammonia Federation are reserving for home consumption the whole of their possible March and April output.

It is to be regretted that, as with nitrate of soda, the farmers' hesitation is complicating an already difficult position. There is a good demand for export, but, owing to lack of supplies, which are not much more than one-third of those before the war, this demand will naturally be met from stocks if they are not previously sold in Britain.

If it be difficult to form a definite opinion of the prospects for the immediate future of the two principal nitrogenous fertilizers, it is doubly difficult in the case of the synthetic nitrogen products. There are optimists and pessimists regarding the future of the nitrogen industry, but in the end that future must depend upon production costs, and also the value that the factories would have to a country in time of war.

Synthetic Products

The chief synthetic products manufactured are :—Sulphate of ammonia, cyanamide, nitrate of soda and nitrate of lime. Germany is the chief producer of synthetic products, and it is officially estimated that for the year 1922-23, the total production of nitrogen in that country will be 340,000 tons, of which about 75,000 tons will be in the form of by-product sulphate of ammonia, and the remainder as synthetic sulphate of ammonia, cyanamide, and a small quantity of nitrate of soda.

It is doubtful whether this estimated amount will be attained, owing particularly to a shortage of coal, but presuming that it is reached, it is stated that this quantity will still fall short of the home requirements by no less than 80,000 tons of nitrogen, equal to, say, 500,000 tons of nitrate of soda. These figures are sufficient to show that in any event Germany will have insufficient nitrogenous fertilizers during the coming season. Cyanamide has not proved popular with the German farmer, and there is a steady demand for nitrate

of soda, which cannot be imported in large quantities owing to the depreciation of the German Exchange. It is noteworthy that the German industry is unable to produce sufficient nitrate of soda owing to the lack of the necessary soda ash, and in addition it is undoubtedly more profitable to the manufacturer to sell his nitrogen in the form of sulphate of ammonia or cyanamide, than to incur the extra cost of converting it to nitrate of soda.

It is evident, therefore, that Germany is not in a position to manufacture sufficient nitrogen for her own requirements, and therefore cannot possibly become a competitor in the world's markets in the near future.

It is now generally accepted that cyanamide *per se* as a fertiliser, does not appeal to the farmer, and will have but little sale as such, though in mixtures a considerable quantity is still used. The world's annual production of cyanamide cannot be stated with certainty, as the productive capacity of the factories is so often confused with the actual production. From a careful study of the information from all available sources, however, it may be taken as approximately 840,000 tons, and it is not considered that this amount will be exceeded in the future. In this connection much has been heard of the possibilities of the Muscle Shoals plant in Alabama, United States, but it remains uncompleted, and many millions of dollars would be required to put the plant into even partial operation.

Instead of expansion there is a growing opinion that the production of cyanamide is likely to be gradually curtailed in all countries, unless a process can be found by which it can be converted cheaply into some other form useful as a fertiliser, such as urea.

The annual production of nitrate of lime, about 100,000 tons, is too small to affect the nitrogen market, and the scarcity of cheap available water power would seem to be a bar to its extension.

From the above considerations one is driven to the conclusion that the synthetic nitrogen industry generally will not for some years play a larger part than it has done in the past.

The Immediate Future

The immediate future for nitrogenous fertilisers rests with nitrate of soda and sulphate of ammonia. Apart from synthetic sulphate, the amount of the latter available will depend upon the general trend of trade, the gas, steel, and oil industries—the quantity cannot be altered at will apart from these factors. The present output of nitrate of soda can easily be doubled, and at gradually reducing cost as the consumption develops, thus allowing of production at full capacity.

In 1922 the world produced a tonnage of inorganic nitrogen approximately equivalent to 3,500,000 tons of nitrate of soda, apart from Chile. If all the oficinas in Chile were working at full time, the yearly output would be nearly 4,000,060 tons, and it will thus be seen that Chile can claim upwards of 50 per cent. of the world's present productive capacity of inorganic nitrogen.

Unfortunately, the troubled times the world has been through and is still going through have lessened the purchasing power of the community at large, so that the demand for nitrogen, as for other products, has fallen below normal.

Yet there is hope in the fact that the farmers of the world are learning to use larger quantities of these fertilisers in the production of their crops, and compared with the value of the crops all fertilisers are cheaper than before the war. It remains with the farmers to make adequate use of them, for it is certain that without them the world cannot be fed, and there is no longer any doubt whatever that their use is a paying proposition.

Notes on the Fertilising Effects of Potash

By G. A. Cowie, M.A., B.Sc., F.I.C.

THE direct crop-increasing capacity of potash dressings, especially under certain conditions of soil and climate, is now well established, but the importance of potash in relation to the health of the crop is, perhaps, not understood as it might be. It has not yet been possible to find a satisfactory explanation for all the observed instances of the invigorating and toning-up effect of potash on the plant, but this is now an accepted truth. In fact it is being increasingly realised, especially by the intensive grower, that a timely potash application is one of the best safeguards against certain types of disease to which crops grown under certain conditions are highly susceptible.

Apart from mitigating or preventing disease a dressing of potash is often effective in increasing the vigour and resistance of the crop against unfavourable influences, chiefly climatic. A drought tends to cause a crop to run its course unduly quickly and ripen off prematurely to the detriment of the yield. The addition of potash in such cases often has the required effect of prolonging the growth. In wet seasons, on the other hand, potash appears to impart stamina to the crops and helps them to overcome the depressing effects of low temperature.

It is not easy to correlate all these effects with the well-ascertained influence of potash on the production or translocation of carbo-hydrates in the plant. Careful investigation has, of course, shown that it is the application in proper proportions of the three-plant food constituents, nitrogen, phosphates and potash, which leads to robust growth, and that the omission of either constituent or the absence of proper balance may produce susceptibility to disease. In this connection a great deal appears to depend on the relation between the nitrogen and potash supply. The presence of a large amount of available nitrogen in connection with a shortage of potash is one of the chief predisposing causes of certain fungus and other troubles. These conditions are favourable to an excessive production of leaf, which is soft in texture and presumably easily invaded by micro-organisms. An increase of the proportion of potash to the nitrogen supply under such conditions has been found to harden the leaf-tissue and to reduce considerably the tendency to disease. At the Cheshunt Research Station a complete fertiliser showed about half the number of plants attacked by bacterial stripe disease in one variety and about one-third of the number in another variety, as compared with an incomplete fertiliser containing no potash. Similarly in the mangold and wheat experiments at Rothamsted, it is the fertiliser dressings, which are distinguished by the same type of absence of balance as the above—viz., the omission of potash alongside the excess of nitrogen, that produce in the crop its marked susceptibility to disease.

The beneficial effect of potash in delaying the ripening of the growth during drought is not easy to explain. A dressing of potash in this case would appear to be a compensating factor for the lack of adequate moisture. An attempt has been made to attribute this effect or a part of this effect to the hygroscopic properties of the potash salts; but the evidence is not satisfactory. A non-hygroscopic salt, like the sulphate of potash will produce the same result. In the droughty season of 1921 this influence of potash dressings was strikingly marked on potatoes. The plants on the plots which received adequate nitrogen and phosphates, but no potash, completed their growth in a remarkably short time, and had died down fully four to six weeks earlier than the plants which received potash along with equal amounts of nitrogen and phosphates. This potassic effect was equally apparent in the increased yields, especially where no dung was used.

It is not yet possible to explain the mechanism of the action of potash in keeping the crop growing during drought. Some evidence indicates that it may produce greater root development. The symptom of potash starvation as shown by the potato foliage appears to be much the same as leaf scorch on fruit trees. In this connection it is interesting to observe that the research work at the Long Ashton Research Station has traced leaf scorch to various groups of causes, with one of which soil conditions are associated. In this case the scorch is associated with inadequate root development, while at the same time an important correlation was found between the amount of potash supply, root-growth and the degree of leaf scorch.

In dry districts there exists a certain predilection for the crude potash salts, on the ground that they help to preserve the moisture in the soil. This is attributed to the hygroscopicity or some other physical property of the secondary constituents of these salts, like salt and magnesia, but it is not proved that the effect in such cases is not a purely potassic one. Even where the result is got from a dressing of common salt, it is always possible that the sodium has had a releasing effect on the potassium in the soil, or may actually have replaced potassium as a plant nutrient, as it has been proved to do in cases where there is a deficiency of potash in the soil. On the other hand it is possible that these different salts may have some effect in helping the capillarity of dry sandy soils, or reducing the rate of water evaporation from the surface. There is a definite need of more investigation to elucidate these points.

The invigorating effect of potash on the crop in bad seasons is demonstrated by the wheat plots at Rothamsted. The average increase in yield from a dressing of potash has been materially greater in years of high rainfall than in years of normal rainfall, and presumably higher temperature. A similar bracing effect of potash has been observed on barley in wet, cold seasons such as the last.

Lime as a Plant Production Factor

Some of its Advantages and Effects

LIME is one of the most important factors in plant production if not the most important. Like many other essentials to plant life, science with practice has been able to produce this element in a form that is far more helpful to plant growth than the old rough and ready method of application which resulted in having lime in some parts of the soil and none in others. Used in the right way and in the proper form, lime is not only an essential soil element but has an important value as a fungicide and insecticide, both in and out of the soil, which is not generally realised. The uses of lime are manifold, and the benefits to be derived from its application are really great.

Hydrated lime, if of a pure nature, is, owing to its fineness, unquestionably the most valuable form for horticultural or agricultural purposes, inasmuch as it is easily assimilated by the soil, and thus its action stimulates in providing food for plant life more naturally and effectively.

Lime acts chemically, physically, and bacteriologically in the soil. It acts *chemically* by hastening decay of organic matter or manures and setting free the elements of plant food they contain, and also by releasing potash, which clay and heavy soils usually contain in abundance, and rendering phosphoric acid more available for the plants. It acts *physically* on a clay or heavy soil by coagulating the particles of soil and making them more granular, so that there is better drainage and greater warmth. The density of a clay or heavy soil is due to the particles of soil being so fine that they hold moisture and bind together. Lime corrects this by making the soil more open and more friable, and consequently easier to cultivate. It is a proved fact that you get an earlier and a better tilth on heavy land that has been properly limed than where it has not been so treated.

Lime acts *bacteriologically* by sweetening the soil and providing a congenial environment for the soil bacteria. The fertility of the soil is due to the action of beneficent bacteria converting the various foods elements present into such a form that the plant can take them up. In performing these functions the bacteria throw out a minute amount of acid, and, unless steps are taken to neutralise this acidity, their surroundings are not healthy; the organisms languish, lose efficiency, and eventually die off. Lime corrects this acidity and enables the bacteria to carry on their beneficent work.

As a *fungicide* lime in the soil is capable of materially lessening and preventing many diseases such as "Finger and Toe," "Club-root," "Anbury," etc., but in every case it should be applied to the surface soil so that the rain may wash it in. If applied more than 4 in. to 6 in. below the surface it is not so effective. Pure lime, correctly hydrated, can be used effectively as a dry spray, as a preventive against many cases of air-carried diseases such as potato and tomato blight and also many other diseases and pests which attack trees, plants, fruits and vegetables, whether under glass or in the open.

Lime in many cases is an effective *insecticide*. For efficiency in this direction much depends on the fineness and purity of the lime and its correct hydration, for it is often quite possible to add too much or not enough moisture. Lime is well known for use against slugs, but it is not generally know that the slug has the power of exuding a slime which enables it to escape from the first powdering its body receives. A second application, however, within a short space of time is beyond its powers and generally destructive.

Lime, suitably prepared for the purpose and used as a dry spray, is an effective preventive against insect pests which attack vegetables, fruit, or flowers, and in practice has at the same time been found to assist the growth of the plant.

It is not only a waste of money to apply fertilisers to land deficient in lime, but it is positively harmful in that you are making the soil more acid. The elements that fertilisers contain are not available as plant food unless there is lime present to set them free, and they cannot become free otherwise. Sulphate of ammonia is very destructive to lime in the soil, and where frequently used liming should on no account be neglected. The same is true where superphosphate is used. Nitrate of soda is also much more effective where lime is present in the soil. This applies both to outdoor or under glass cultivation.

Lime varies as much as coal in regard to quality. When you purchase ordinary lime you may buy something else besides lime. This something else may be silica (sand) or alumina (clay) or, what is worst of all for horticultural or agricultural purposes, magnesia. This is usually present in most soils in sufficient quantity for all ordinary purposes, and is of importance as a constituent in soils where vines are grown. For horticultural or agricultural purposes it is the opinion that lime should not contain more than 2 per cent. of magnesia and less than 1 per cent. is preferable. Nevertheless, some qualities may contain up to 40 per cent.

Chalk, which is frequently used, is slow in its action, and in the opinion of many does not possess the sterilising action of lime burnt in the kiln. Moreover, chalk frequently contains an excessive amount of moisture, and when applied to the soil there is the likelihood of its becoming pasty, which makes even distribution impossible. In this state it may cake and thus prevent proper aeration.

Buxton has long been known to possess some of the purest deposits of limestone in the world. The Buxton Lime Firms Co., Ltd., convert a considerable quantity of this limestone into lime which analyses up to 98·40 per cent. of lime (C a O). This lime possesses the physical property of breaking up into a particularly fine state of division. The company are scientifically hydrating this lime by a special secret process and sending it out in the form of lime powder. This product is known under the proprietary name of Limbux.

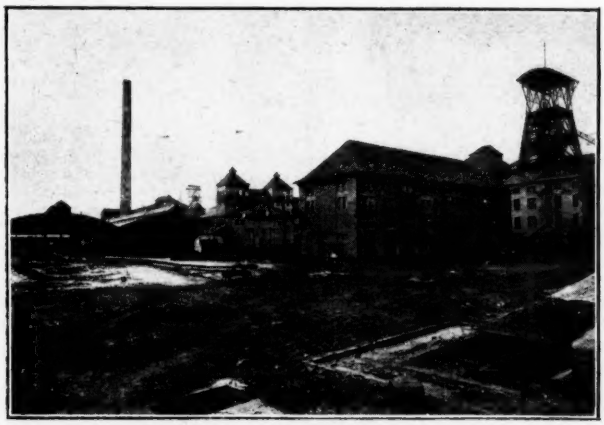
The initial cost of pure lime such as this may be a little more than that of an inferior grade, but the distribution cost is the same, and there is efficacy in every ounce, added to which is the consideration of its uses as a dry spray, a fungicide and an insecticide. It can be applied as a dry spray to fruit trees, etc., in bloom without scorching or doing any damage; in fact, it appears to assist pollination.

The question is often asked whether all soils are sufficiently and properly limed to assist in maximum crops of agricultural and horticultural products. Lime is an essential plant food and a most necessary soil element, and soils without lime cannot produce good crops, not forgetting, of course, that "lime and lime without manure, will make both land and grower poor." Not only is lime constantly absorbed in neutralising the acid products in the soil, but it is also removed by the action of rain or drainage in England, Scotland and Wales at the rate of approximately 500 lb. per acre annually. Unless this is replaced or made good from time to time the normal standard of soil productivity cannot be maintained.

The French Potash Industry in 1922

Output More than Doubled

THE French Potash Industry during the past year was confined within economic limits, in so far as arrangements for the sinking of fresh shafts and the construction of new mines

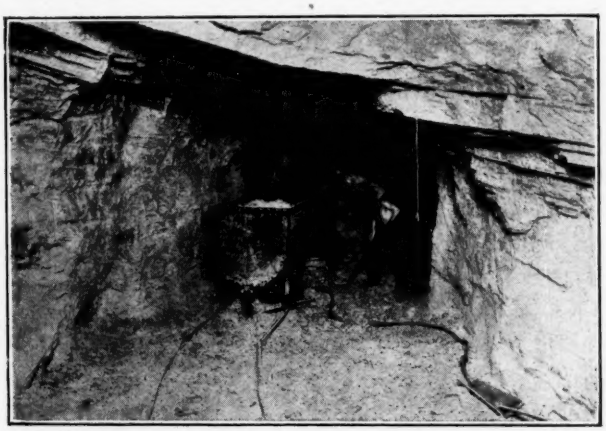


GENERAL VIEW OF MINES AND FACTORIES

and factories were carried out, yet notwithstanding this limitation the output from the existing mines was higher and the proportionate expansion of the industry, as gauged by total sales and exports, greater than in any previous year. The official reports dealing with production and sales show that the output of these mines last year was no less than 1,350,000 metric tons of potash salts, equivalent to 230,000 metric tons of pure potash (K_2O). This production marks a record in the French potash industry, and undoubtedly the achievement is highly satisfactory in comparison with the output for the period prior to the recession of Alsace-Lorraine to France. In view of the increased competition and the general downward trend of prices in the world's markets during the past few years, the improved position of these mines may be regarded as an indication that the potash industry in Alsace is being developed and maintained on sound economic lines.

Comparative Figures

The following table giving the total production of crude salts and the equivalent of pure potash produced by the

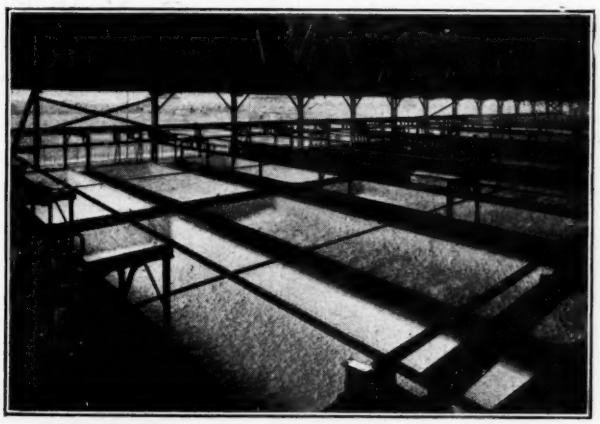


MINERS AT WORK

Alsatian mines as from 1913, when the potash deposits in Alsace were held by the German Potash Syndicate, provides an interesting retrospect of the progress made in the development of the Alsatian potash field since it passed into the hands of the French companies after the armistice in 1918 :—

Year	Crude Potash Salts (Metric tons).	Potash K_2O (Metric tons).
1913.....	355,341	62,540
1914.....	325,880	57,455
1915.....	114,358	20,127
1916.....	204,474	35,987
1917.....	320,131	56,343
1918.....	333,499	58,695
1919.....	464,605	92,006
1920.....	1,061,196	199,175
1921.....	900,000	110,500
1922.....	1,350,000	230,000

On comparing these figures, it will be observed that the average yearly production during the past few years has been more than three times that of 1913. It will also be noted that the industry has made good recovery from the set-back which it received in 1921, when the agricultural depression in America and other countries caused a restriction in the demand for potash. The statistics for the past year show that the amount



MANUFACTURE OF MURIATE OF POTASH

of pure potash extracted from the Alsatian mines was more than double that of the previous year. More important, however, as an indication of the value of the Alsatian potash deposits to France are the figures showing the quantities of potash exported. The subjoined statement provides a comparison of exports for the period from January 1 to September 30 in each year from 1920 to 1922 :—

	Metric tons of Potash Salts	Metric tons of Pure Potash
January 1 to September 30, 1920....	757,077	140,248
January 1 to September 30, 1921....	367,577	85,037
January 1 to September 30, 1922....	706,698	169,684

It will be seen that the exports during the above-mentioned period in 1922 increased nearly 100 per cent. The percentage of potash was also higher, as indicated in the figures showing the tonnage of pure potash as against crude salts. This was in great measure due to the increased exportations of concentrated salts from factories which were able to increase their output of muriate and sulphate of potash.

A greater range of qualities of potash salts was also supplied by the French potash mines last year in order to provide suitable grades for individual requirements.

The following table gives the analyses of the various grades exported. It will be noted that the percentage of potash in

the natural salts from Alsace is higher than that provided in the qualities supplied from other sources.

FRENCH POTASH SALTS
AVERAGE ANALYSES OF AVERAGE SAMPLES.

	Potash K_2O	KCl	NaCl	$MgCl_2$	K_2SO_4	Na_2SO_4	$MgSO_4$	$CaSO_4$	H_2O	Insol.
French Kainit, 14/16% (Sylvinite)	15·0	23·7	62·3	·15	—	—	—	2·5	1·15	10·2
French Manure Salts, 20/22% (Sylvinite)	21·0	33·2	53·8	·16	—	—	—	2·1	1·34	9·4
French Manure Salts, 30/32% (Sylvinite)	31·0	49·0	41·2	·10	—	—	—	1·5	1·00	7·2
Muriate of Potash, 80/82%	52·0	82·3	8·7	·8	—	—	—	—	1·8	6·4
Muriate of Potash, 96/98%	61·5	97·3	2·0	·2	—	—	—	—	·3	·2
Sulphate of Potash, 90/96%	50·6	—	—	·95	93·6	1·30	—	1·80	1·15	1·20

A grade known as Sylvinite 40% is also provided.

Manufacture of Concentrated Salts

At the factories where muriate of potash is extracted from the crude salts efforts were made to reduce the cost of production, and considerable success was achieved in technical improvements to reduce the consumption of coal and to avoid wastage in the mined product. The principal factories operating last year were at the mines Amelie, Reichsland, Theodore and Alex. Two more were under construction at the Marie Louise and Joseph Else mines. Other factories for the production of sulphate of potash were operating in the principal manufacturing centres of Northern France.

Future Developments

By a special law passed on March 26, 1921, the French State becomes the owner of the Alsatian mines, but the system to be adopted for the ultimate working of these mines has not yet been officially decided. Several systems have been proposed, and recently it was agreed that a single organisation should control both the technical and commercial transactions of the mines. With regard to financial interests, however, the Government is opposed to the principle of control by a single large company, because that would institute a monopoly.

J. C. W.

The Use of Lime in Agriculture

By N. V. S. Knibbs, B.Sc.

Historical

The astonishingly rapid growth of pure and applied science during the latter years of the nineteenth century was not an unmixed blessing to all industries, and perhaps one of its worst consequences was the tendency towards a too implicit reliance upon the necessarily incomplete knowledge gained by brief research in the laboratory. Practical experience extending over centuries was ignored; because no reason could be seen for following it.

In agriculture the problem of manuring seemed to resolve itself into the supply of adequate quantities of certain chemical substances, in particular combined nitrogen, phosphorus and potassium. Chemical manures were introduced especially to supply these elements, and they immediately proved a great success, apparently confirming the laboratory work up to the hilt. Our ancestors had for centuries used lime—the word is here used in its broadest sense to cover quicklime, hydrate of lime and carbonate of lime, whether chalk, marl or hard limestone—and considered it essential to good husbandry; but experiment showed that the plant took up only very small quantities of the element calcium, and that soils, almost without exception, contained more than enough for this purpose. Why, then, apply lime?

In justice to the agricultural chemists of that time it must be admitted that they very soon found that the mere supply of certain chemicals by no means solved the problem of maintaining the fertility of the soil, and gradually the influence of organic matter and of lime was recognised and explained. Meantime, however, the farmer had found convincing evidence of the apparent truth of the chemists' too hasty conclusions. Artificial manures, at least when supplemented by dung, acted like a charm, and fertility was maintained for years without applying any lime.

It is now known that this continued fertility was due to the large surplus stock of lime which the wisdom of our ancestors had laid up in the soil, and this stock lasted so long that when at last it was exhausted the practice of liming had been almost forgotten. It has taken many years to convince the farmer that his ancestor was right, but fortunately the value of lime is now generally recognised.

The Nature of Soil

Soil is a mixture of inorganic particles formed by the decay of rocks, organic matter from the decay of vegetation, and micro-organic animal and vegetable life. To be fertile it is necessary that it should contain certain chemical substances, and be nearly free from others, that it should be nearly neutral in reaction, and that it should be in suitable physical condition to allow drainage and aeration and to maintain the right conditions of temperature. Since the soil micro-flora play a fundamental part in plant growth, it is essential that the soil should be in a condition suitable to their spread and activity.

Physical and Chemical Effects of Lime

Soil is essentially colloidal, and its physical condition, especially if it is a clay or fine silt soil, is dependent upon the presence of small quantities of chemicals which flocculate or dispense the colloidal soil particles. Lime flocculates a clay soil, and therefore liming is of the utmost importance in maintaining the physical condition of such soils.

The purely chemical effects of lime have not been investigated very thoroughly. Probably it hastens the decay of the rock particles of the soil, and hence the liberation of potash, and it may increase the availability of phosphorus in a soil very deficient in lime. It also reduces the toxicity of metallic soil-poisons, such as copper and zinc salts.

Bacteriological Effects of Lime

The part played by lime in the control of the soil micro-organisms is of even greater importance than its physical and chemical influences. The soil flora are concerned with the decay of organic matter to form humus, the break-up of nitrogenous substances, the formation of nitrogen compounds which may be assimilated by the plant, and with the fixation of atmospheric nitrogen, and all the organisms which engage in these activities are sensitive to acid soil conditions, and require lime to enable them to function normally. In peat, for example, decay is entirely arrested, and with it fertility, but if peat is limed it rapidly decays and its character is changed completely.

The only form in which nitrogen is assimilated by the plant is as nitrate, and when it is supplied in any other form it must be converted into nitrate by some soil process before it is available as a plant food. Sulphate of ammonia, for example, is valueless until the ammonia is oxidised to nitric acid. This is accomplished in the soil by the activity of two organisms: "Nitrosomonos" which converts the ammonia into nitrate and "Nitrobacter" which further oxidises the nitrite to nitrate. Both bacteria are very sensitive to an acid medium, which reduces their activity enormously, and lime should, therefore, be present to neutralise the acid as it is formed.

Soils which have been manured with sulphate of ammonia and not supplied with lime for some years present a striking

appearance, The vegetation may be actually starved of nitrogen because it is present in an unassimilable form. On dressing with lime they rapidly resume a high fertility.

The most important nitrogen fixing organisms are those which function in the roots of leguminous plants. Since all the leguminosæ are very sensitive to acidity, and thrive best when the soil is well limed, the importance of lime to nitrogen fixation at once becomes evident.

Magnesian Lime

There has been a great deal of controversy as to the best form of lime to use, and as to the effect of magnesia in the lime. Regarding the latter it is established that it is unwise to use a magnesian lime on a soil already rich in magnesia, but that on most ordinary soils a magnesian lime has no ill-effects, the magnesia being effective in neutralising soil acidity. Since dolomite and magnesian limestone are less readily soluble in acids than pure limestone, it is to be expected that ground dolomite will be less effective than ground high-calcium limestone, and this expectation has been confirmed by experiment.

Caustic Lime or Carbonate?

The three compounds used in agriculture are the oxide, the hydroxide, and the carbonate. Experimental evidence as to the relative values of the different compounds is inconclusive and often misleading, and there has been a great deal of nonsense written by partisans of each side of the controversy. Since caustic lime, the oxide or the hydroxide, is converted into the carbonate by the atmosphere very soon after it is applied, it is obvious that contentions such as that which attribute destruction of the soil humus to caustic lime are untenable. Such destruction is a relatively slow process, and the lime will all be carbonated before it has become appreciable. The fact is that lime in any form promotes the activity of the organisms concerned in the decay of organic matter, and the more rapid decay when caustic lime is used merely shows that it is the more active form.

The carbonate formed in the soil from burnt lime or hydrate of lime is in a very much finer state of sub-division than the most prolonged grinding can bring about, and therefore this carbonate is more active than carbonate applied as such. That is to say, burnt lime must necessarily be more effective than the equivalent quantity of ground limestone or chalk. Experiment has shown, however, that limestone ground to pass a screen of 200 meshes to the linear inch falls very little short of caustic lime in its neutralising effect on soil acidity.

The oxide and the hydroxide are much more effective than the carbonate in improving the tilth of a clay soil, and they may also influence favourably the fertility by causing partial sterilisation of the soil, with a consequent decrease in the numbers of soil protozoa. The protozoa are soil fauna which destroy the soil bacteria, and therefore deleteriously influence plant growth. They are much more sensitive than the bacteria to heat, cold and weak antiseptics.

The Form in which to apply Lime

In former times lime was usually applied to the soil in lump form, the powder resulting from atmospheric slaking being worked into the soil. Obviously this is a costly and inefficient method of distribution, and it is now more usual to apply ground lime, hydrate, or carbonate, by means of a mechanical distributor. Ground lime has the disadvantage that it is difficult to store, because it swells and bursts the bags holding it. Also it is inclined to inflame the eyes and the tender parts of the skin of the horses used to draw the distributor, unless the day be an exceptionally calm one. Hydrate of lime and pulverised carbonate share the virtues of being easily stored and handled, and of not being objectionable to distribute. Unfortunately hydrate has in the past been very difficult to procure except at a prohibitive price, and the carbonate has usually been supplied in too coarse a form to be really effective.

This state of affairs has now been altered, and a very pure high-grade hydrate of lime may be purchased at a reasonable price. Limestone, too, is being ground very finely by some firms, but unfortunately the price is correspondingly high. To be economical in use the price delivered of the most finely-ground carbonate should not be more than half that of good burnt lime.

These two products—the hydrate and the finely-ground carbonate—are coming more and more into use as the standard agricultural lime products, and when their advantages are fully realised it is improbable that quicklime whether in lump form or ground, will be used at all.

Hydrate of Lime

Taking all factors into consideration hydrate of lime is the most satisfactory liming material, and it may therefore be of interest to consider briefly the methods used in its manufacture. It is a regrettable fact that there have been and still are lime producers who market any kind of inferior lime powder as "hydrate of lime." Air-slaked lime, the fine lime and ashes from mixed-feed kilns, even dried water-softener sludge, have been sold under this name, and as a consequence hydrate has fallen into disrepute in some quarters.

Hydrate of lime should be made from good lump lime by the addition of pure water. There are several machines which may be used for carrying out the operation mechanically, and they are quite satisfactory if the proper adjustment of lime and water feeds is made. Such hydrators combine means of feeding the lime and water with agitators for stirring the mass and sufficient capacity to allow for the time necessary for completion of the reaction. It is also necessary to permit the free escape of the heat of reaction, so as to avoid overheating the hydrate. The hydrate coming from the machine should be passed through a screen to take out lumps of unburnt limestone and of unslaked lime.

Hydrate made in this manner from a good white lime is a pure white powder which does not swell on standing in a moist atmosphere, which is convenient to store and handle, and which is rapid in its action on the soil.

Chemical Treatment of Plant Pests

WINTER is the most suitable time for an onslaught against the various insect and fungous pests that infest gardens and orchards. In the first place, the fruit trees are better able to withstand a good spraying, without being injured, during their winter rest; in the second place, the pests have aggregated for the winter months in certain parts where they can readily be destroyed. The winter campaign is, therefore, to be regarded not only as a preventive measure, but also as the main attack. If certain pests are not entirely eradicated, further supplementary efforts have to be made in the following spring and summer. Should, however, the winter effort be neglected, the subsequent campaign in spring and summer is of little use, especially if the pests are in strong force.

In order to avoid a planless, unsystematic effort and the extra labour which this would involve, it may be pointed out that a dry summer brings many insect pests in its train, whilst a wet summer, like the last, causes an increase in fungous pests. The fight this winter should, therefore, be directed chiefly against the latter.

The best and simplest method of destroying these pests is by spraying with Solbar or Carbolineum, or by banding. Before spraying, the trees have to be carefully scraped or brushed with a sharp brush in order to remove bits of bark and other loose portions under which the insects usually congregate.

The branches of the trees must be thinned, for if they are very close together they favour the spread of the pests. The winter spraying should be performed when there is neither rain nor frost. If rain falls during the spraying operation or immediately after, the liquid that has been sprayed on the trees will be partly or completely washed away, and thereby rendered more or less ineffective, whilst during frosty weather the plants may be injured through a coating of ice being formed.

As already stated, this winter it is chiefly fungous pests that have to be combated. Consequently the sulphur product Solbar, which is obtainable from seedsmen and dry stores, etc., is the scientific remedy to use. Solbar has the advantage over old-fashioned lime-sulphur washes of being supplied in the form of a highly concentrated powder which only needs to be dissolved in water to be ready for use. In winter a 5 per cent. solution of Solbar is advised. This will be found effective against the common fruit scab (Fusicladium), and especially the very injurious apple mildew and American gooseberry mildew. In cases of mildew, the branches affected should be pruned before spraying. It is also advisable to apply the same remedy for Monilia (brown rot and blossom wilt). Here, too, all diseased wood should be entirely cut out and burned.

In order to suppress mildew on apple trees, the trees should be sprayed in spring shortly before the buds appear, with a 1 per cent. Solbar solution, an operation that must be repeated after the fruit begins to form and the trees are in full leaf. In the case of a severe attack, the spraying operation should be repeated once more, or even several times if necessary, a few weeks later. It is also advisable to spray in winter with a stronger Solbar solution (5 per cent.) as an effective preventive.

The insect pests that can be effectively cleared by Solbar include scale insects. The parts attacked should be thoroughly scraped or brushed and then treated with a 5 per cent. solution. American blight or woolly aphis, a pest that causes great damage to the branches and twigs of apple trees and is recognised by its white woolly covering, can be eradicated by spraying or brushing with Ustin solution. Care should be taken to lay bare the base of the trunk and to examine it thoroughly for aphides, for they often hibernate at this spot. Many kinds of insects are caught by banding, and this method of control is recommended against the apple blossom weevil, codling moth, winter moth, March moth and mottled umber moth. The first two hibernate in the bark of the tree. The brown tail moth spends the winter in its web or tent at the top of the tree and the ends of the branches. These tents must be cut off and burnt. Spraying in winter and early spring before the buds appear, say from the end of February to the beginning of April, will be found serviceable against the apple blossom weevil; such spraying will also destroy the eggs of other insects.

The soil of nursery beds is often badly infested with mildews and other soil fungi, and should be sterilised. The simplest scientific way is to remove the soil and to mix it thoroughly with a 0·25 per cent. Uspulun solution, using a shovel for the operation. By sterilising in this manner many plant diseases and pests are suppressed—*e.g.*, finger-and-toe disease (club root).

Great benefit may be derived by pickling or dressing the seeds of early nursery vegetables with Uspulun in order to avoid diseases being introduced by the seeds. This dressing operation is a very important means of preventing leaf rust in the case of cucumber, leaf spot disease of peas, etc.

Mildew on plants wintering in the greenhouse or in early nursery beds can be combated with a 1 per cent. Solbar solution. Red spider and thrips are destroyed in the same way.

W. J. W.

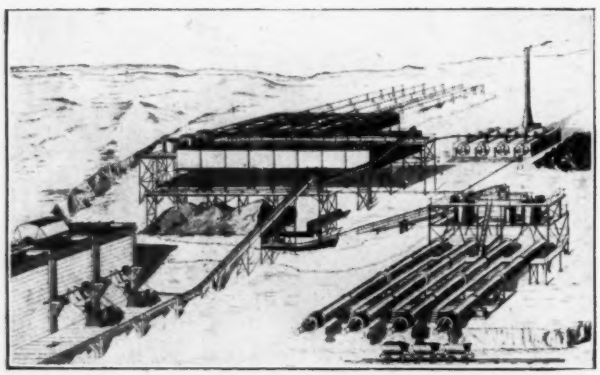
The Butters Nitrate Process

Notes on the Process and Plant

In view of the recent references to the Butters Nitrate Process, the following notes, supplied by the firm, give a general idea of the process and plant.

During the last forty years Chile nitrate has been elaborated by a system of lixiviation, in which strong liquors, for the purpose of crystallisation, are enriched by contact with the nitrate content of the raw material. In the course of the impoverishment of the raw material the strong liquors are succeeded by weaker liquors, and finally by water. This system had much to commend it when treating good quality caliche, but the exhaustion of rich grounds has necessitated the utilisation of lower grade material and the employment of improved methods of treatment.

The enemy most to be feared in any system of lixiviation is the presence of fines, yet, on nitrate grounds to-day, they



Panoramic View of Plant.

constitute a large proportion of the nitrate bearing material, and, as time goes on, the proportion of fines must inevitably increase. The fines, when lixiviated with hot liquors form with them slimy borras and sludges, and these, owing to their unbleachable nature, are most difficult to free from their nitrate liquor, of which, in present practice, a large amount is consequently lost.

With a view to minimising the production of fines, insufficient crushing is given the raw material, which leaves the caliche in lumps too large for the solvent liquors to penetrate and dissolve the nitrate in the cores. This is not, however, the only impediment to a thorough dissolution of the nitrate contents, as the borras and sludges present form an impervious coating around the lumps of caliche, thus preventing the solvent liquors from effectively attacking them.

The Butters Nitrate Process completely overcomes all these difficulties by separating the fines and dust from the coarse particles, and these, when free from the sludge-forming elements, can be given an efficient lixiviation. No longer hampered by the production of fines, the raw material can be crushed sufficiently to ensure proper dissolution of the nitrate contents.

Description of Process and Plant

The Butters Process is carried out in three stages:—(1) Separation of the fines from the coarse material by means of vibrating screens; (2) dissolution of the nitrate contents of the fines in agitation cooking tanks; (3) filtration of the pulp in Butters pressure filters.

The raw material brought from the pampa to the ore bin is delivered to jaw crushers, as at present, and, after crushing, is carried on a belt conveyor to a screening plant. The coarse material, comprising pieces of ¼ in. in size and larger passing over the screen, is fed to a belt conveyor and thence delivered direct to the cachuchos for treatment by existing methods. The fines, consisting of material smaller than ¼ in. in size, passing through the screens, fall on to a tray beneath and are delivered to a belt conveyor, and, in turn, carried to the Butters plant.

The Butters plant is arranged in units for the separate treatment of individual charges and comprises equipment for screening, conveying filtering and discharging.

The screening plant consists of vibrating screens. Each of these is a rectangular frame carrying a wire mesh of ¼ in. holes and provided with the means to keep the screen in constant vibration, which assists the fine material to pass through. Each screen is provided at its upper end with a distribution chute to spread the material evenly over the wire mesh and a tray beneath the mesh to catch the fines which pass through, whilst a separate chute is provided at the lower end to discharge the coarse material which passes over the screen.

The agitation and heating tank is circular and conical bottomed, 7 ft. 6 in. in diameter by 8 ft. deep, provided with an agitator and steam heating coil. The tank is lagged with non-conducting material on side and bottom, and covered with a wooden top to prevent loss of heat.

The agitator consists of a three-bladed propellor suspended near the bottom of the tank on the end of a vertical shaft operated at 100 r.p.m. through bevel gearing. The steam heating coil consists of a spiral of tubing disposed in the lower half of the tank with inlet connection from the steam boilers and outlet drain to the condensed water return main.

The filter consists of a cylindrical chamber, 40 ft. long and 42 in. in diameter, provided with a filter bed covering the whole of its inner circumference. It is closed at both ends and the shell perforated with a series of holes through which the filtered liquor passes out. It is supported at the charge end by a hollow axle mounted on a bearing, and near the discharge end by a tyre riveted to the shell and supported by rollers. Resting on these supports it is caused to rotate by suitable means. The filter bed is composed of a series of cement asbestos boards covered with Monel metal cloth, lying closely together lengthwise in the cylinder and made to conform to the inner surface of the shell by angle irons bolted to it. Each board discharges its filtered liquor through the perforation of the shell into an annular launder. The " discharge " end of the filter is fitted with a door, operated by an hydraulic cylinder. The whole of the shell is covered with non-conducting material to prevent the escape of heat.

The auxiliary plant comprises suitable conveyors, tanks, piping, launders, pumps, motor and power transmission.

Operation of Plant

The plant is operated independently of the existing maquina, and the fines on leaving the screening plant are conveyed to the agitation and cooking tank as required. A charge consists of from six to seven tons of fines (according to the ley of the material) and 2,000 litres of prepared liquor, made up of agua vieja and caldillo of 450 to 500 grams of nitrate per litre. The charge on entering the agitation and cooking tank is reduced to a thick pulp by means of the propeller and heated by the steam coil. After 55 minutes' cooking a temperature of 110° cent. is attained and the nitrate dissolved. A valve in the bottom of the cooking tank is then opened, and the charge, which is now ready for filtration, runs by gravity to the filter. The pulp, compressed air, and the wash liquor are introduced to the filter through a short pipe at the charge end.

The filter on receiving its charge is caused to revolve, and compressed air is simultaneously admitted. The compressed air, by reason of its pressure, separates the liquor from the solids, the former escaping through nozzles into a stationary annular launder and thence to the caldo tanks. As the filter revolves the solids are built up on its inner surface, layer upon layer, into a cake, and held thereto by the air pressure.

During the formation of the cake the effluent issuing from the filter is a caldo containing 700 grams to 750 grams of nitrate per litre, which is run by way of the caldo launder to the caldo tanks and thence to the bateas. Filtration is continued until the formation of cake is complete, and the signal of this stage having been reached is the blowing of air instead of liquor through the nozzles of the filter. The cake now left inside the filter represents the solids separated from the liquor, except that portion of the latter retained by the cake as moisture, which is subsequently recovered by two displacement washes.

The first of the displacement washes consists of 500 litres of hot relave, containing 350 grams to 400 grams of nitrate per litre, which, after being measured in a drum, is introduced to the filter, and filtration continued as before. This wash prevents dilution of caldo by acting as a cushion between the caldo it displaces and the water wash by which it is succeeded, and, at the same time, serves to bring into solution any nitrate left undissolved in the cake.

The second wash consists of 900 litres to 1,000 litres of water, which, after measuring, is introduced to the filter and filtration again continued. At the commencement of the second wash the effluent is still of caldo strength, but after a few minutes it gradually becomes weaker. As the effiuent drops from a caldo to a caldillo it is diverted from the caldo launder to the caldillo launder by means of a movable spout, and, as it further decreases in strength, it is finally diverted to the relave launder.

After the second wash, 90 per cent. of the nitrate contents of the raw material treated has been recovered in the form of caldo ready for crystallising in the bateas. The caldillo and relaves produced are kept in " closed circuit " cycle after cycle for the purpose of subsequent enrichment. The cake left adhering to the filter on release of the air pressure immediately falls from its perimetrical bed, rolls itself into a loaf, and, by means of angle irons inside the filter so disposed as to form a helix, is wound out through the discharge opening and sent to the dump.

The time required for the completion of a cycle is as follows :

	Minutes.
Filling filter	5
Forming cake	40
Washing cake with relave	30
Washing cake with water	35
Discharge	10
	120

Each unit has a capacity of 80 tons of dry fines per 24-hour day.

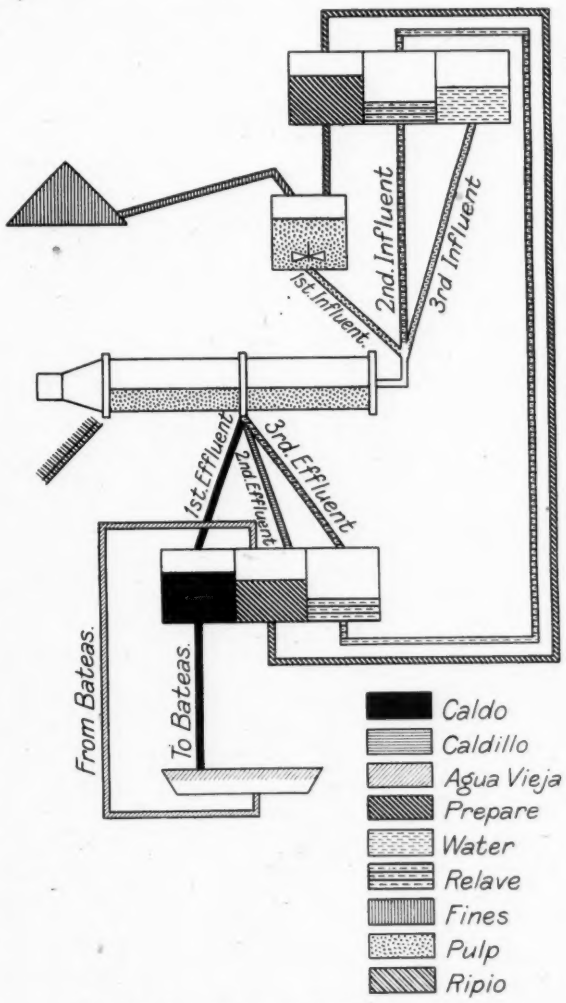


DIAGRAM ILLUSTRATING OPERATION OF PLANT

The Butters Process in the treatment of fines recovers 90 per cent. of the nitrate contents, removes the difficulties encountered in present practice, disposes of the need for sorting on the pampa, and increases enormously the reserves of nitrate grounds. One of the principal advantages is the production of crystallisable caldos direct from low ley material. The thorough agitation and heating given the raw material dissolves the whole of the nitrate contents with a minimum amount of liquor. The crystallisable caldo is separated from the impoverished material without dilution. The plant produces a crsytallisable caldo from raw material having a nitrate content as low as 8 per cent. The short time required in heating the raw material effects an economy of more than one half of the present fuel consumption.

The Problem of Dust Explosions in Industry—II.

By W. E. Gibbs, D.Sc.

The author, who is the chief chemist to the Salt Union, Ltd., and the author of "Disperse Systems in Gases" and papers on "The Industrial Treatment of Fumes and Dusty Gases," discusses comprehensively what is described as the dust hazard in industry and methods of providing against it. We give below the conclusion of the article the first instalment of which appeared last week.

Experimental Results

It is found experimentally that, for a given dust-air mixture, there is an optimum concentration of dust at which the combustion is most rapid and complete—*i.e.*, most explosive. As in a gas-air mixture, this composition corresponds approximately to the combining proportions of the dust and the oxygen in the air, although it is modified considerably, according to the fineness of the dust and the amount of incombustible material present in it. With coal, 123 gms. of dust per cubic metre, and with starch dust, 220 gms. per cubic metre, are found to give a maximum explosion. Generally speaking, the finer the dust and the purer the substance, the more closely it approximates in behaviour to a gas.

In dusts such as coal dust, the optimum concentration is also found to depend to some extent upon the nature of the coal—its content of volatile matter and ash. It has been suggested that the explosive character of coal dust is to be attributed to the rapid production of inflammable gas by the heated coal dust. There is no doubt that the presence of even small amounts of inflammable gas greatly facilitates the explosion of coal or other inflammable dusts, but there is no reason to suppose that the presence of inflammable gas is necessary to produce a dust explosion. Many dusts are explosive which, when heated well above the ignition temperature, do not give off any inflammable gas—for example, aluminium, starch. The explosion of a dust-air mixture is evidently initiated and maintained by the direct combustion of the dust itself. Its violence is directly due to the high velocity of combustion, consequent upon the very large specific surface of the dispersed combustible.

Concentration of Dust

As the concentration of dust departs from the optimum concentration, the mixture becomes less inflammable. The relation between the concentration of lycopodium dust, and the pressure developed by the combustion of the corresponding cloud, is shown in Table I. The inflammability of the dust cloud, as measured by the pressure generated by its combustion, diminishes as the concentration of dust is increased or decreased beyond the optimum value. Beyond a lower and an upper limit of concentration the dust cloud is no longer inflammable.

TABLE I.

Relation between Concentration of Dust and Inflammability of Cloud.

Concentration of Dust. Gms. per 100 ccs.	Pressure. Lbs. per sq. in.
·02	33
·03	52
·05	60
·10	33
·15	19
·35	9
·50	7

The minimum concentration at which coal dust becomes explosive is from 23 to 40 gms. per cubic metre, according to the nature of the coal. A bituminous coal dust is generally more easily ignited than anthracite. A coal of high ash content is less easily ignited than one with little ash. Some dusts—for example, certain kinds of starch—are more readily ignited than coal dust, and produce a more violent explosion. The relative inflammability of a number of dusts, as indicated by the pressure produced by their combustion, is given in Table II. It is found that a cloud of flour dust ignites and burns very similarly to coal dust. Starch dust burns with twice as high a flame velocity as some coal dusts, and generates from eight to ten times as much pressure.

TABLE II.

Dust.	Pressure generated. Lbs. per sq. in.	Dust.	Pressure generated. Lbs. per sq. in.
Lycopodium	17·5	Fertiliser dust (grinding dry tankage)	10·5
Dextrine	14·6	Pittsburgh stand: Coal	10·1
Wheat starch	14·0	Cocoa	9·1
Tan bark dust	13·3	Sulphur flour	8·8
Wood dust	12·8	Rice bran dust	8·7
Wheat dust	12·6	Ground cork dust	7·4
Wheat elevator	12·5	Powdered Milk	7·1
Sugar	12·2	Charcoal	3·6
Linseed Meal	11·7	Flax dust	3·2

Fineness of Dust

It has been shown experimentally that the inflammability of a given dust increases with its fineness. This is illustrated in Table III., in which various samples of dust, separated into fractions of different degrees of fineness are compared. It will be noticed that in practically every case, the finer dust is more inflammable than the coarser dust, although the difference is hardly as great as might be expected. The order of inflammability of the coarser fractions of the six dusts examined is very different from that of the finer fractions.

TABLE III.

Dust. Maximum size Particles.	Pressure lbs. per sq. in.						
	·02	·025	·03	·04	·05	·06	·11 mm.
Wood dust	18·3	—	18·1	—	15·5	—	10·6
Oat and Corn	15·7	—	—	14·2	—	—	8·7
Potato Starch	14·5	—	14·0	—	12·8	—	11·1
Pittsburgh Coal	—	—	12·5	—	10·3	—	3·9
Wheat Flour	—	14·9	—	13·9	—	12·5	9·6
Cocoa	—	—	7·3	11·3	—	10·7	10·2

It is probable that the shape of the particles is as important a factor as the fineness, in determining the amount of surface exposed to the air by a given weight of the dust, and hence its inflammability.

Effect of Ash

In Table IV. the retarding influence of the incombustible portion of the dust is illustrated, with various samples of rice dusts. Although, for a given dust, an increase in the percentage of incombustible matter reduces the inflammability, yet the percentage of ash that can be present in an explosive dust varies within very wide limits: thus, rice dust may contain 57 per cent. of ash and still be inflammable, while carbon dust may contain only 4 per cent. of ash and be incapable of ignition.

TABLE IV.

Effect of Ash on Inflammability of Rice Dusts.

Dust.	Explosion pressure. Lbs. per sq. in.	Ash. per cent.
Rice polish dust from polisher	10·1	8·06
Rice polish dust from collector around polisher	9·3	7·05
Rice bran dust	8·7	21·49
Rice dust from cleaning	7·9	29·33
Rice dust	7·1	35·52
Rice dust from shaker	4·8	53·40
Rice dust from bins above cyclone from receiving aspirator	4·8	56·77
Rice dust from clippers	3·9	50·40
Cyclone dust from rough rice receiving aspirator	0·0	47·66

Volatile Matter

During the temperature rise that precedes ignition, any constituent of the dust that is volatile at temperatures below the ignition point will be set free, the more readily the finer the dust. If the dust is damp, this volatile matter will not be evolved until the water has been driven off. The volatile

matter may be inflammable—coal dust—or it may be non-inflammable—starch or cellulose. With coal dust, it is generally agreed that the liberation of inflammable gas and vapours from the dust may lower the ignition temperature, and facilitate the explosion of the dust.

The formation of inflammable vapour or gas from the dust is clearly not essential to the propagation of a dust explosion, since starch and cellulose explode very readily, and even finely divided metal dusts, such as aluminium, have been known to explode violently.

Moisture

Moist dust has a higher ignition temperature than the same dust when dried. This is because some of the heat of ignition is absorbed by the evaporation of the water. The extent to which the ignition point is raised by the moisture differs with different substances. It is impossible, by adding moisture, to render coal dust absolutely and theoretically incombustible; it would require six or seven times its weight of water. Potato starch dust, after drying at 100° C., will explode violently, but is quite incombustible if it contains 10 per cent. of moisture. On the other hand, wheat smut dust, containing 35 per cent. moisture, has been ignited easily. Generally speaking, if a dust is not too wet to form a cloud in the air, it is not too wet to explode, provided the concentration is high enough.

Ignition

From a practical standpoint the factors that determine the possibility of the ignition of the dust are, perhaps, the most important. The temperature of ignition of a given dust cloud varies, according to the character of the source of ignition. Some dust clouds require a large source of heat of some duration —for example, a gas flame. Others are easily combustible and can be ignited by an electric spark. The inflammability of a given dust cloud is greatly modified according to the temperature of the source of ignition. In Table V the pressure developed by the combustion of different kinds of dust is compared for different ignition temperatures. It will be noticed that the order of inflammability of the dusts in the first column differs very markedly from the order in the second column.

TABLE V.

Effect of Ignition Temperatures on Inflammability.

Dust.	Pressure, lbs. per sq. in. Ignition temperature.	
	1200° C.	800° C.
Stinking smut of wheat	21·4	0·6
White dextrine	15·5	7·6
Canary dextrine	14·9	7·9
Wheat starch	14·1	8·5
Corn starch	12·6	6·7
Sugar, lump pulverised to pass 200-mesh	13·0	7·5
Dark canary dextrine	15·1	7·3
Potato flour	10·4	6·2
Rice starch	12·3	5·3

Ignition tests with an arc lamp, an oil lamp and a candle flame, carried out with various dusts, show a wide variation in the ease of ignition and the violence of the resulting explosion. A sample of rice dust that is easily exploded by a candle flame could not be ignited by an electric arc. A coal dust, that ignited weakly with an arc, exploded violently with a candle flame. Flour exploded readily with each source of ignition. Corn elevator dust that was not ignited by an arc or candle flame, could burn round the flame of the oil lamp, but combustion was not propagated. In the classification published in the CHEMICAL AGE of last week (page 54), the lowest temperatures are given at which various dust clouds will ignite when allowed to fall through a small porcelain tube heated to a definite temperature, and containing a roll of copper gauze. In this case propagation is facilitated, since the whole of the cloud is heated. Higher ignition temperatures will be required to ignite such dusts at a single point.

Effect of Inert Dust

The explosion of a dust cloud can be restrained, or entirely prevented, by mixing with it a suitable proportion of inert dust, such as shale or limestone. Starch dust, for example, is easily exploded by a candle flame or arc, but a mixture of 30 per cent. starch and 70 per cent. shale cannot be ignited by either. Similarly, a mixture of 40 per cent. flour and 60 per cent. shale dust cannot be exploded by an arc. A dust cloud consisting of 40 per cent. sulphur and 60 per cent. shale can be exploded easily by a candle flame, but 30 per cent. sulphur, mixed with 70 per cent. shale dust, cannot. A mixture of 50 per cent. flour dust with 50 per cent. shale dust can be exploded by a candle flame, but is not ignited by an arc.

Fine shale and limestone dust are used in coal mines to check the propagation of a coal dust explosion. The dust is contained on shelves or in boxes that are suspended from the roof of the mine galleries at various points, high enough to be clear of traffic. They are tripped by the advancing explosion wave, and discharge the dust into the air beneath, thus diluting the coal dust already present in the air, and effectively check further propagation of the explosion.

Flame Velocity

The maximum velocity of flame propagation that has been observed during experiments with gas mixtures ranges from 5,000 ft. per second for a mixture of carbon monoxide and oxygen, to 9,000 ft. per second for a mixture of hydrogen and oxygen. During experiments with coal dust at different times flame velocities of over 3,000 ft. per second have been observed, while in certain tests there were indications that the velocity exceeded 6,000 ft. per second. The flame velocity is increased by increasing the fineness of the dust, or by mixing a small amount of inflammable gas with the dust, and is higher the more free the dust is from ash and moisture.

Explosion Pressures

Experiments made with coal, flour, starch, etc., indicate that the pressures that are developed when these dusts are exploded are of the same order as those developed in gas explosions. In large-scale experiments with coal dusts pressures have been obtained as high as 270 lb. per sq. in.

When starch and other factory dusts, that are more inflammable than coal dust, are exploded in a closed gallery or tunnel, they are found to burn with as much as twice the velocity of coal dust, and may produce eight or ten times as much pressure. In an actual factory explosion these maximum values of flame velocity and pressure are never approached, for factory buildings are not constructed to withstand explosions, and collapse long before the pressure has risen to these values.

The Practical Problem

There is only one way by which dust explosions in a factory can be absolutely avoided, and that is by removing the dust as soon as it is formed. In a modern factory all grinding and disintegrating appliances are, wherever possible, enclosed in casings. The dusty air inside these casings is drawn away by suction, and passed through an air filter of the bag or other suitable type. In this way the dust is recovered, effecting an economy in proportion to its value, the factory air is kept clean, and the physiological and explosion hazards are eliminated. When installing such a dust-removal system it is necessary to place the fan on the exhaust side of the air-filter, so that only dust-free air comes into contact with it. Explosions have occurred in dust-extracting systems, owing to spark formation in the fan itself, through pieces of metal or other foreign material striking the fan-blades.

In many factories much can be done to reduce the risk of explosion by diluting the air in the neighbourhood of the machines with flue gas. This also involves the necessity for enclosing the machines, but, where the dust is not valuable and where the introduction of a dust-extraction system would be difficult and costly, this method has certain advantages.

These methods, however, are only of limited application, and there still remains a variety of plants and processes and machines in which other methods must be adopted. The risk of explosion will depend upon the possibility of forming an explosive mixture, and the occurrence of a suitable means of ignition. Adequate ventilation may do much to check the concentration of dust in the air beyond a safe limit, but there are always places where the air is relatively stagnant, and where dust can accumulate. It frequently happens that dust accumulates on roof beams and girders, from which it may become dislodged, to form an explosive cloud in the air beneath. Similarly, dust that has accumulated on the floor may be stirred up by the breaking of a belt. The disastrous explosion in Liverpool in 1911, to whch reference has already been made, was attributed to the blowing of an uncovered fuse on a temporary switchboard at the very moment when a large belt broke, and stirred up a dense cloud of accumulated

dust. The accumulation of dust on walls, windows, floors and roof should be prevented by frequent sweeping, or, better still, by suction cleaning.

There are many possible sources of ignition in a factory. There is always the possibility of criminal carelessness on the part of employees and staff, through smoking, and the use of matches and other forms of open flames or lights. Such practices should be rigidly prohibited in any factory in which explosive dust is produced. In most modern factories electric light and power are used, and, although this eliminates the danger from gas flames and oil lamps, etc., it introduces the possibility of ignition by electric sparks. Such a spark may be formed at the brush of a motor, or by the blowing of a fuse, or the breaking of a switch or cut-out, by short-circuiting, or by the breaking of an electric-light bulb.

Dust may be directly heated to its ignition temperature by settling on an electric-light bulb, or on a hot metal surface, heated, for example, by friction. Instances of the latter have occurred frequently in grain elevators in America, where the elevator has become choked at the top, and the pulley, rotating in the mass of grain, has generated sufficient heat to ignite the grain. This danger has been eliminated largely by the introduction of a non-chokeable elevator-head.

Sparks may be formed in grinding machines and disintegrators by nails and bolts and other foreign matter getting into the machine, along with the material to be ground. This accidental intrusion of foreign matter can be prevented by installing pneumatic or magnetic separators.

In dry climates—for example, certain parts of America and Australia,etc., ignition has been traced to the generation of static electricity by the friction between belts and pulleys, and between grinding machines and the dry material that is being ground. This has been shown to be a common cause of fires and explosions in cotton-gins and in grain-threshing machines. It is said that in certain parts of America at threshing time the relative humidity of the atmosphere falls to as low as 10 per cent. In this country, owing to the much greater atmospheric humidity that ordinarily prevails, the danger from the accumulation of static electricity would appear to be much less. This possible source of ignition is satisfactorily eliminated in practice, either by humidifying the atmosphere in the neighbourhood of the machines, so that the frictional electricity leaks away instead of accumulating, or, better still, by introducing earthed collectors to remove the electricity from the belts and machinery as it forms.

Conclusion

Much remains to be done to establish conclusively the precise physical character and chemical behaviour of liquid and solid substances when they are dispersed in a gas. The problem belongs essentially to the domain of colloid chemistry. Related problems are those associated with the combustion of powdered coal and atomised oil. Although most industrial dust is relatively coarse, there is generally a proportion of it that is sufficiently highly dispersed to exhibit active Brownian motion. It is possible that this relatively small proportion of highly dispersed dust may, in some circumstances, play an important part in determining the behaviour of the whole cloud.

The investigations that are reviewed in the present article were prompted by the urgency of the practical problem; they have yielded important results, that are of immediate practical value to the safety of all who work in proximity to explosive dust. The information that has been obtained laso contributes much to a more complete understanding of the chemical behaviour of matter when in the colloidal condition.

BIBLIOGRAPHY.

1. Wheeler, R. V. *Report on the Inflammability and Capacity for Transmitting Explosions of Carbonaceous Dusts Liable to be Generated in Workshops and Factories.* Home Office, Cd. 6662, March, 1913. *Engineering* (1913), 95, 606-7. *J.S.C.I.* (1913). 32, 447.
2. Dedrick, B. W., R. B. Fehr and D. J. Price. *Grain Dust Explosions.* U.S. Dept. Agriculture, Bull. 681 (1918).
3. Gibbs, W. E. *Disperse Systems in Gases.* Fourth Colloid Report, British Association (1922). H.M. Stationery Office.
4. Price, D. J., and H. H. Brown. *Dust Explosions* (1922). (National Fire Protection Association, Boston, Mass.), pp. 246, 42 illustrations, 39 diagrams, 4 plates, 25 tables, and a good bibliography.

Scottish Chemists' Dinner

The Importance of Chemistry in Industry

THE annual dinner of the Edinburgh Sections of the Institute of Chemistry and of the Society of Chemical Industry was held in the Royal Hotel, Edinburgh, on January 20. Dr. H. G. Watt, F.I.C., chairman of the Edinburgh and East of Scotland section of the Society of Chemical Industry, presided. The guests of the evening were Mr. A. Chaston Chapman, F.I.C., F.R.S., Mr. R. B. Pilcher, Dr. E. F. Armstrong, F.R.S., Sir James Walker. The company, which numbered fifty ladies and gentlemen, included Lady Walker, Mrs. Watt, Dr. J. P. Longstaff, Professor Barger, Dr. Dobbin, Dr. Lauder, Mr. J. Rutherford Hill and Mr. W. A. Williams.

Mr. R. B. PILCHER, proposing the toast of "Chemistry and Industry," said they were fortunate in having with them the presidents of the three leading chemical societies—Sir James Walker, Mr. Chaston Chapman and Dr. Armstrong. There were few there present who did not know the importance of chemistry in its application to industry. Referring to the influence of chemistry on the manufactures carried on in Edinburgh, Mr. Pilcher referred particularly to brewing, distilling, iron and steel, gas, rubber, paper, and oil. He coupled with the toast the names of Mr. A. Chaston Chapman and Dr. Armstrong.

Mr. CHASTON CHAPMAN, in responding to the toast, referred to the useful work done by the various sections of the Institute had helped the executive in London to appreciate the members wherever they happened to be. The report of the Council showed that they had some 4,000 Fellows on their register and 1,000 registered students. Chemistry was an instrument of education and must be an essential part of the intellectual equipment of every cultured man.

Chemistry and National Defence

With regard to the importance of chemistry in the arts and manufactures, continued Mr. Chaston Chapman, it was well known that there were very few industries in this country which could be carried on successfully for a single day without the help of chemistry. As a factor in the production of material wealth chemistry must stand right at the top, and surely what the world needed at the present time was the creation of new wealth rather than squabbling as to how the little the war had left should be divided. No decent person wanted war but nobody could say that it was entirely out of the question. If it did come, he said, the chemist would be the country's main line of defence. It was well that the nation should realise what chemists were and that without the chemist every section of the community—the capitalist, the workman, the financier, even the politician—was powerless. They should be proud to belong to such a profession and they should make it their business to understand what chemistry meant and do everything in their power to see that chemistry stood well in the eyes of the public.

Dr. E. F. ARMSTRONG, who replied for industry, said a great deal had been heard of what chemistry had done for industry, and he believed that industry and particularly chemical industry in this country had done a great deal for chemistry. It was only by the existence of a real friendship between industry and chemistry that both sides would make progress. Great harm had been done to chemistry during the last few years because unqualified men had walked into the industry using the term chemist when there was a shortage of chemists, the best chemists being engaged elsewhere, and as a consequence, chemistry had had a certain set-back in industry. They had to put that right by seeing that only qualified people were supported and allowed to use the title "Chemist." They must not forget that in addition to being chemists they must also be men; it was not only their knowledge of chemistry that helped them to get on. Chemistry up to a few years ago was not very highly organised and it was only of late years, owing to the efforts of men like Mr. Pilcher and Dr. Longstaff, that it had been made more effective. He would like to see the societies independent of each other but federated much more closely, one super body acting and speaking for them all, and speaking with one voice and that a loud one, when they had to deal with the public or the Government.

Dr. DOBBIN proposed the toast of "The Guests, to which Dr. Longstaff replied. The toast of "The Chairman" was proposed by Dr. T. W. Drinkwater.

Society of Dyers and Colourists

Manchester Section

A MEETING of the Manchester Section of the Society of Dyers and Colourists was held on January 19, Mr. William Marshall, F.I.C., presiding. Papers on "The Behaviour of Titanic Acid towards Dyestuffs," by Dr. J. K. Wood, F.I.C., and A. M. Morley, M.Sc., A.I.C.; and "Investigations on the Constituents of Raw Cotton," by Professor E. Knecht, and G. H. Streat, M.Sc., were read.

The Behaviour of Titanic Acid

In reading the first paper Dr. Wood said the element titanium occurred in the fourth group of the periodic classification, together with silicon, zirconium, tin and other elements. These elements formed hydroxides which were amphoteric in character, and which were commonly referred to as acids. It had been customary to consider these substances as capable of existing in two modifications, known respectively as alpha and beta acids, and showing a considerable difference in behaviour towards reagents. Although the practice had been to speak of only two varieties of the various acids, the facts recorded in the literature would suggest that more than two modifications were obtainable, according to the methods of preparation which were employed. It was, however, extremely doubtful whether the substances referred to were definite hydrates of the oxide of the elements in question, and the opinion had gained ground in recent years that the difference between the so-called modifications of these acids was really due to a difference in size of their primary particles. The ortho acid, now commonly referred to as the alpha variety, was considered to exist in the form of small particles which were more readily attacked by reagents than the larger and more complex of the meta, or, as it was now commonly called, the beta acid.

Amphoteric Character of Oxides

If the difference in property was really due to the size of the particles it would be seen that this opened up the possibility of the existence of a number of modifications of the acids which would be in harmony with the behaviour as recorded in the literature. It had long been known that it was possible for the alpha modifications of these acids to be transformed into the beta varieties, and that, in turn, the beta might, under certain conditions, be reconverted into the alpha varieties, but no definite explanation of these changes and of the causes which operated to bring them about was offered until a few months ago, when, as the result of experiments on the stannic acids, Mr. Collins and himself suggested that the gradual change in the structure and properties of these modifications might be traced to the amphoteric character of the oxides in question.

Mr. Collins and himself had shown by papers published last year that the hypothesis was in agreement with the behaviour of stannic acids under varying conditions, and they also suggested that the isomerism of the analogous compounds of titanium, zirconium, and other elements, might similarly be accounted for. Numerous experiments which had been made with Mr. Morley showed that this supposition that the explanation of the isomerism of the titanic acids was due to a similar cause was justified, so that in regard to titanium hydroxide or titanic acids it might be assumed that between the so-called alpha titanic acid and the beta titanic acid, just as with stannic acids, there was a series of substances of gradually increasing complexity of their ultimate particles, and that there was really a continuous series of these substances gradually increasing in beta character as a process of condensation took place as the result of the titanium hydroxide functioning in two capacities. This, said Dr. Wood, was more or less a theoretical statement which it was necessary to bear in mind with regard to the present position of knowledge regarding these so-called isomeric acids. One result of a process of condensation would be the gradual decrease in the total surface of the particles, because by the fusion owing to the process of condensation of several simple particles together, a complex particle was created which must have a smaller surface than those from which it had been formed. Inasmuch as adsorption was a surface phenomenon it would be anticipated that, other things being equal, a sample of titanic acid having a pronounced beta character would possess a smaller adsorptive capacity than one in which the process of condensation had proceeded to a lesser degree.

A considerable number of experiments in support of the authors' deductions were then explained.

Constituents of Raw Cotton

Dr. Knecht said that the paper was really a second communication on cotton wax. In an account of the systematic extraction of the bleached cotton yarn which had been heated for 336 hours in a sealed tube at 93° it was stated that the benzene extracted amounted to 0·3, alcohol 0·6 and water also 0·6 per cent. A partial confirmation of the assumption that these extracts were due to treatment in bleaching was obtained at the time by extracting some grey Egyptian yarn to exhaustion with benzene, then bleaching it, and extracting again with benzene, when a not inconsiderable further extract was obtained. The experiment was repeated later by Fernandez, and it was found not only benzene but also alcohol and water gave further extracts after bleaching. It was further ascertained that cotton which had been thoroughly bleached yielded, after being smashed to powder on an anvil, considerable amounts of extracts. Further work on this subject had now been carried out and the results generally confirm those previously obtained.

Briefly stated, the experiments showed that extraction of the raw cotton with benzene only removed the wax to the extent of about one half, but that if the fibre substance was destroyed or disintegrated by chemical or mechanical means the whole of the wax could be extracted and was then found to amount to somewhat over 1 per cent. A further examination of cotton wax had revealed the presence of what appeared to be another definite compound which differed in solubility, melting point and composition from that described by Schunck.

Sir Max Muspratt on the Ruhr Occupation

IN his presidential address to the Widnes Chamber of Commerce on Tuesday, Sir Max Muspratt said that almost to a man Great Britain believed that France was chasing a will-o'-the-wisp. We wanted to maintain the deepest sympathy for our tried Ally, but the extremely difficult task which was thrown upon us was to see that that phantom did not turn into a spectre to haunt Europe for countless generations to come. We wanted, he said, to minimise a possible catastrophe which might come from the present events in the Ruhr Valley. The first effect of the action of France might be beneficial to Widnes, Lancashire, and even Great Britain on the material side. We might get a sporadic boom in coal, steel, and chemicals, but we must bear in mind that any immediate benefit that we might get might prove a setback to the world's progress which was threatened at the present time.

Difference between Drugs and Medicines Explained

AT the Mansion House last week, William Bredt, an agent for chemicals and drugs, of Fenchurch Street, was summoned by the Commissioners of Customs and Excise for selling foreign medicines called "Bromural tablets" and "Styptol tablets" without a paper wrapper and label duly stamped. The Lord Mayor, in a considered judgment, said by the Act of 1812 "foreign medicines of all kinds, except drugs" were liable to duty. These tablets were made in Germany, and the question was whether they were drugs excepted from duty. On behalf of the customs it was contended that the drugs so made into tablets became medicines and ceased to be drugs. He decided that these tablets were medicines and not drugs. As the defendant might have thought he was acting rightly, he should mitigate the penalty to £6 and £15 15s. costs.

New American Sulphuric Acid Process

THE discovery of a process by which sulphuric acid, potash, and alumina may be extracted from alunite is reported from America; it being suggested in some quarters that a revolution will be effected in the manufacture of these products On the other hand, the problem of producing sulphuric acid more cheaply or more effectively than by the chamber or contact processes is generally regarded as a very difficult one. In connection with this process it appears that a subsidiary of the Armour Fertiliser Co. is producing potash, and the Florence Mining and Milling Co. are now making alumina and sulphuric acid as by-products in obtaining the potash.

Empire Mineral Resources

Presidential Address by Professor G. T. Morgan

In the course of his presidential address on "The Empire's Resources in the Less Common Metals," delivered on Monday before the University of Birmingham Chemical Society, Professor G. T. Morgan expressed the opinion that a highly developed industry in coal tar products leads with unfailing certainty to proficiency in other chemical arts. The interdependence of all branches of chemical trade had been demonstrated up to the hilt by the development of chemical industry in Germany. The great Rhenish firms were something more than commercial undertakings: they were technological universities of the highest grade. It was largely owing to the educational leaven of these scientifically directed enterprises that Germany had gained her supremacy and prosperity in the main branches of chemical industry. The utilisation of atmospheric nitrogen, many modern metallurgical processes, scientific glassware, synthetic rubber and the highly profitable trades in drugs, photographic chemicals, synthetic tanning materials, artificial resins, synthetic essences and other fine chemicals had arisen as offshoots of the scientific industry in coal tar dyewares. These colour factories afforded a training to the chemist and chemical engineer which at present was hardly to be obtained in any other country or in any other branch of industry. Public men and leaders of industry should realise that in regard to the safeguarding of our natural resources in *materia chemica* there was only one strategic chemical front, and we could not fall behind in any particular branch of chemical industry without grave risks of losing ground in all the correlated industries.

Ultra-light Alloys

Professor Morgan referred to the Empire's resources in the precious metals gold and silver and also to the light metals aluminium, magnesium and beryllium, which are of special interest in the production of light alloys. Ultra-light alloys were now being produced by the Magnesium Co., Ltd., of Wolverhampton. The metals of the less common earths were utilised chiefly in the form of their compounds. Barium and strontium preparations were largely derived from British sources, and the world's requirements for thoria and ceria employed in the incandescent mantle industry were largely supplied from the extensive Travancore deposits, which would meet the demand for many years. The favourable situation of the Empire in regard to the supply of tungsten minerals should place us in a premier position for manufacturing tungsten steel.

In the development of our mineral resources it was essential to take the long view. Systematic research was needed even on chemical elements which had not hitherto received industrial application. Zirconium was cited as an instance of a metal which had so far been examined chiefly by German and American chemists, the English contribution to this branch of mineral chemistry being very small. Cobalt was another example of a metal which merited increased attention, the annual production being only of the order of 400 tons.

The Platinum Group

There was a world famine in regard to the valuable metals of the platinum group owing to the partial failure of the Russian supply, but these metals had also been detected in many parts of the British Empire. Tasmania had furnished osmium and iridium, while the Sudbury nickel-copper ores of Ontario had yielded notable quantities of platinum and palladium. Cobalt was a metal with a future, coming into use now as an alloy metal instead of being restricted, as it was until recently, to use in combination as a pigment colouring material. Cobalt conferred hardness and durability on aluminium.

Referring to magnesium, Professor Morgan pointed out that the metal, which has exceptional lightness, is permanent under ordinary atmospheric conditions, especially when free from impurities. Minute quantities of such foreign substances as alkalis or chlorides caused local granular corrosion. The metallurgy of magnesium depended on electrolytic processes, and considerable progress in this isolation had been made in the United States.

Isolation of Beryllium

On the subject of beryllium Professor Morgan said that, owing largely to the scarcity of beryllium minerals, comparatively little headway had been made in the isolation of beryllium, although the physical constants of this metal showed that it would be a valuable aid in the production of light alloys, providing that a sufficient supply of its minerals was forthcoming. The commonest of these minerals, beryl, was, he said, an acidic silicate of beryllium and aluminium, $3BeO$, Al_2O_3, $6SiO_2$, occurring both in the old world and the new. A well-known deposit existed at Limoges, in France, and considerable quantities had been noted in New Hampshire, where beryl crystals of enormous size up to 2½ tons occurred. Within the British Empire there was a small unexploited deposit in Glen Cullen, Co. Dublin. It was also found in the former German colony of S.W. Africa. Hitherto only small quantities of beryllium metal had been produced. The first difficulty encountered in the metallurgy of beryllium was the separation of beryllium from alumina.

Beryl was an acidic felspar like orthoclase, and was not appreciably attacked by the common mineral acids. It was opened up, however, by fusion with caustic alkali, this re-agent forming alkali silicate and yielding a mixture of alumina and beryllium carbonate. Subsequent treatment with dilute sulphuric acid precipitated silica. The filtrate contained beryllium and aluminium sulphate, and if the alkali used in the fusion contained potash, a good deal of aluminium sulphate crystallised in the form of potash alum and was thus separated. The beryllium remaining in solution as the more soluble sulphate was separated partially from the remaining aluminium by taking advantage of its solubility in ammonium carbonate, this re-agent precipitating aluminium hydroxide. By diluting and boiling the solution hydrated beryllia was precipitated and converted into the basic acetate. $BeO_4(CH_3.CO_2)6$, a co-ordination compound of considerable stability which, although only sparingly soluble in water, had the remarkable property of dissolving in such organic solvents as acetone, chloroform, benzene, etc. This beryllium derivative had a definite melting point, and when pure could be sublimed without decomposition. These singular characteristics rendered it useful in the final separation of beryllia from alumina.

Professor Morgan then described two other processes which had been tried with good results in the Chemical Department at Birmingham. It was found that whatever process was employed the final purification was best effected through the basic acetate.

Aluminium was the only fairly plentiful metal of the light metal group; some of the others, such as scandium, gallium, indium and thallium being excessively rare. Yttrium and lanthanum belonged to the metals of the rare earths, comprising some eighteen elements, of which certainly two had met with industrial application. These were thorium and cerium.

"Westminster Bank, Ltd."

An extraordinary general meeting of the London County Westminster and Parr's Bank, Ltd., will be held at the head office of the bank, 41, Lothbury, London, E.C., on Thursday, February 1, at 12.45 p.m., following the ordinary general meeting of the company, when the following resotion will be submitted as an extraordinary resolution:—"Resolved that the name of the company be and is hereby changed to 'Westminster Bank, Ltd.'" Should the above resolution be passed by the requisite majority it will be submitted for confirmation as a special resolution to a further extraordinary general meeting of the company, which will be held at the same place on Friday, February 16, at 1 p.m.

Affairs of Ascott's Drug Stores

Mr. G. T, Ascoli, trading as Ascott's Drug Stores, 13, Prince of Wales Road, Kentish Town, London, against whose estate a receiving order was made on January 31, 1922, attended at the London Bankruptcy Court on January 17, for public examination. A statement of his affairs (*See* The Chemical Age, Vol. VI, p. 487), showed unsecured liabilities £4,733, and assets valued at £372. Examined by the Official Receiver, the debtor said that he had never drawn a penny from the business. He attributed its failure to the neglect of his son, who managed the business and also to the fact that his son drew sums far in excess of his salary. The examination was concluded.

Rubber Research Association

Effect of Co-operative Research on Works Chemists

At a meeting of the Manchester Section of the Institution of Rubber Industry on Monday, Mr. B. D. Porritt, F.I.C., Director of the Research Association of British Rubber and Tyre Manufacturers, read a paper on " The Scope and Progress of the Research Association."

Outlining the activities of the Association, Mr. Porritt said it was formed at the end of 1919, its membership being open to all *bona fide* British rubber manufacturers. In framing the Articles of Association, those responsible for the enterprise did not overlook the fact that the applications of science to industry are many and varied in character, and accordingly the field of scientific and educational activities was left as open as possible to provide for all contingencies which might arise.

Link between Pure and Applied Science

The Association was concerned not so much with the importance of technical research as with the more practical problem of the best means of securing more intimate relationship between science and industry, and it provided a link between pure and applied science which had been wanting in the past.

Mr. Porritt emphasised the point that co-operative research must not be regarded as a substitute for the works chemist or physicist, and so far from diminishing the number of scientific men engaged, it should rather increase it. Trade co-operation in research not only co-ordinated science with industry, but also provided another link between commerce and the State.

Properties of Rubber

At present singularly little was known about the properties of rubber. Who could answer the question what took place during vulcanisation, or why the rubber, on vulcanisation, became more prone to oxidation. Fundamental research was slow, and the methods depended upon the result of practical experience. It could be generally accepted that the chief details of technical practice were common knowledge to all engaged in the various branches of the industry, and probably the only secret which was of vital importance to the manufacturer was the secret of successful management. The processes in the rubber factory bristled with problems awaiting investigation. There was no reason to fear that the field for discovery was exhausted. The Research Association had now largely overcome the initial difficulties which beset every new enterprise and required only support and encouragement to develop its activities, and to demonstrate to the consumer and to the foreign competitor that the British manufacturer was determined to keep abreast of the times.

In the course of the discussion, Capt. Grey urged that the first fundamental point was to get rubber alike. In the old days there were so many different varieties that mastication was a great difficulty. At the beginning of the Association the growers said they could not standardise rubber, but he believed they had now taken that matter in hand.

Properties of Carbon Black

Mr. Porritt gave some particulars of the work upon which the Association was at present engaged. One subject was the properties of carbon black, an investigation of the wide differences between various grades—gas blacks, blacks prepared from acetylene, and blacks prepared from vegetable oils. They differed in physical properties for no apparent reason, and systematic analysis and testing of a wide range of samples should be of considerable value to the works chemist.—Mr. Swallow pointed out the importance of knowing the origin of the carbon blacks used, and asked how they were to compel the supplier to give them the information. As matters stood at present, they got one black, say from the United States, which was all right, and another, possibly from another part of America, which gave different results.

Mr. Brooking asked whether the Research Association was investigating the use of coal tar colours or other colours with indiarubber goods. He thought there was an immense field for development in that respect. Mr. Ferario raised the question of the effect of vulcanisation of the rubber upon cloth whether dyed or bleached or even grey, and suggested that the Research Association should take up those problems. Mr. Porritt said, so far as he knew, the question of dyes for rubber product had not yet been included among the research problems, but he would include it in his next list. In the investigation of carbon black they would co-ordinate the analytical tests with the results of physical tests, and possibly be able to devise a method which would enable the laboratory chemist to sort out the good from the bad.

Disinfectant Manufacturers' Trading Losses

A meeting of the creditors of The Milton Manufacturing Co., Ltd., 21, Chiswell Street, London, E.C., and 125, Bunhill Row, London, E.C., was held on January 18, at the Institute of Chartered Accountants, Moorgate Place, London, when the chair was taken by Mr. Howard G. Dunkley, the liquidator appointed by the shareholders at a recent meeting. The Chairman said that the company was incorporated on October 28, 1916, and that the total cash capital provided had amounted to £157,507.

Dealing with the trading the chairman said that the first period after incorporation was the period up to December 31, 1918, and in this period the sales amounted to £18,400. For the year ending December 31, 1919, the sales were £44,000 and in 1920 they were £92,000. For the year ended December 31, 1921, the sales were £39,800, and for 1922, £26,500. The first trading and profit and loss account for the period to December, 1918, showed that the proceeds of the sales had been only sufficient to cover salaries and advertising, and there was a loss in this period of £20,400. Towards the end of 1919 negotiations were entered into with a view to the company's products being exploited in the American market, and a contract was entered into with Alexander D. Shaw and Co., with whom difficulties arose later which might be the subject of litigation. The chairman said that a statement of affairs made up as at December 29, 1922, showed that the liabilities amounted to £37,598, while the assets were estimated at £10,432. There was an apparent deficiency as regards creditors of £27,166, but the figures he had given did not take into account anything in regard to the company's goodwill, trade marks, patents, etc. There should undoubtedly be a considerable value in the foreign rights, for, notwithstanding the disastrous results of the trading, the article was believed to be a good one, and properly handled, ought, it was thought, to yield a profit. The failure of the company had been due to a very expensive organisation, and the difficulty of establishing a trade sufficient to meet the necessary expenses which had been involved.

A resolution was then moved by a creditor that the liquidator appointed by the shareholders should not be confirmed in his appointment, but that another liquidator be appointed in the person of Mr. J. L. Goodwin. This resolution was put to the meeting, but was declared to be lost. A committee of inspection was then appointed.

On Tuesday, in the Companies' Winding-Up Court, Mr. Justice Eve made no order on the petition of H. Page-Croft for the winding-up of the Milton Manufacturing Co., Ltd., the company being in voluntary liquidation.

A Bankrupt's Discharge Suspended

Mr. Hugh Augustus Hughes, 5, Moorgate Street Buildings, London, E.C., who failed in July last (see The Chemical Age, Vol. VII, p. 617), applied at the London Bankruptcy Court last week for an order of discharge. His liabilities were estimated at £8,374, and the assets had realised 38s. 8d. Mr. F. Vyvyan, Official Receiver, reported that the debtor had failed on a previous occasion, namely in June, 1914, when, after carrying on business as a gum merchant, he was adjudged bankrupt in the High Court. He obtained his discharge in November, 1915, subject to a suspension of two years. In 1916, he formed H. A. Hughes, Ltd., colour merchants, of which he was appointed managing director, but in March, 1921, the company went into voluntary liquidation. The debtor afterwards had the use of an office at 5, Moorgate Street Buildings, E.C., and acted as a commission agent, dealing principally in dry colours. He attributed his insolvency to the failure of H. A. Hughes, Ltd., his largest unsecured liability (£8,244) being in respect of a guarantee given on behalf of the company. Mr. Registrar Francke suspended the discharge for two years and six months.

American Chemist Awarded Perkin Medal

THE Perkin Medal, an annual award for the most notable achievement in applied chemistry, was presented to Dr. M. C. Whitaker on January 12, by the American Section of the Society of Chemical Industry at the Chemists' Club, New York. The presentation was made in recognition of a series of achievements prominent among which was Dr. Whitaker's recent work culminating in the continuous industrial production of ethyl acetate. In his paper of acceptance of the Perkin Medal, Dr. Whitaker described the work of the organisation of the U.S. Industrial Chemical Co., of which he is president, in converting a plant hastily erected at Baltimore during the war into an efficient experimental plant.

The problem, he stated, was to work large volumes of dilute acetic acid varying in concentration from 0 per cent. to 15 per cent. Old, standardised methods and materials were not available then. Some new light had to be thrown on the chemistry of esterification and the product of these reactions. Intensive researches resulted in the discovery that sulphuric acid, in very low concentrations, is an excellent catalyst, or accelerator, and reduces the time required to complete the reaction to 150 minutes. He also described the experimental plant built from war equipment which operated for some months at a profit. It was the model on which a large scale plant, and then a second unit, were built. They now produce anhydrous, chemically pure ethyl acetate by the continuous esterification of dilute acetic acid, at the rate of 150,000 gallons per month.

Dr. Whitaker is a director of the American Chemical Society, and vice president of the U.S. Industrial Alcohol Co. He was for six years editor of *Industrial and Engineering Chemistry* and at various times in his career has held important academic positions. From 1911 to 1917 he was professor of chemical engineering at Columbia University.

Tennants' Acquisition of China Clay Business

TENNANTS (LANCASHIRE), LTD., of 1, Booth Street, Manchester, announce that they have purchased the old-established business of Winser and Co., mineral and chemical merchants, conducted for some years at 312, Deansgate, and Castle Street, Knott Mill, Manchester, and have also arranged to continue the sales agency of the Gotham Co., Ltd., of Nottingham and Carlisle, for mineral white, plaster of Paris, and all gypsum products.

Mr. G. H. Wakeman, in a circular announcing the change, dated January 1, says: "I beg to inform you that I have this day disposed of my china clay, barytes, whiting, French chalk, etc., business, of Winser and Co., to Messrs. Tennants (Lancashire), Ltd., which firm, having been in the chemical trade for over 100 years, is no doubt well known to you. I thank you for the confidence extended to my firm for the last 60 years, and trust the same pleasant relations will exist under my successors. I ought to add that the local representation for the sale of mineral white and plaster of Paris made by the Gotham Co., Ltd., of Nottingham (7 mills and works, including those of the Carlisle Plaster and Cement Co.), which has been in my hands since 1903, is taken over by Messrs. Tennants (Lancashire), Ltd."

German Potash in the U.S.A.

IN connection with the report published in THE CHEMICAL AGE last week to the effect that the Deutsches Kalisyndikat is organising a syndicate to handle its products in New York, the Hamburg correspondent of *The Times* states that Mr. Zimbin, an American financier, has purchased shares in the company to the value of 100,000,000 marks, through a large banking house, and is shortly to become a member of the board of the German company. This company, the report continues, produced during the last year about 1,300,000 tons of pure potash, while the world's requirements are estimated at 1,600,000 tons. The exports for last year amounted to over 350,000 tons, of which 125,000 tons went to the United States. Figures for the last quarter of the year are so far unobtainable. It is considered that as a result of co-operation with the United States syndicate the increase in exports to North America should exceed 300,000 tons. The formation of the syndicate is reported to have led to a large demand for potash shares, which have appreciated considerably in consequence.

Reported Discovery of New Elements

ACCORDING to a Copenhagen message, Professor Niels Bohr has announced the discovery of a new element, No. 71, to which the name Danium has been given. It is said to have been found in coal, and the discovery furnishes proof, according to Professor Bohr, of the correctness of several of the theories which he has advanced.

Another discovery by two Danish chemists, Messrs. D. Coster and G. Hevesy, was described by the authors in *Nature* last week, from which it appears that they have found the element 92, to which they have given the name Hafnium, after Hafniae (Copenhagen). Their investigations were made by examination of the X-ray spectra of extractions of zirconium minerals, as a result of which they think it very probable that ordinary zirconium contains at least from 0·01 to 0·1 per cent. of the new element which, they state, must be an homologue of zirconium. Further experiments are being undertaken to isolate Hafnium and to determine its chemical properties.

It will be recollected that Moseley, the young British physicist who lost his life at Gallipoli, not only discovered the method of investigation by X-ray spectra, but was able to arrange the known elements in an orderly series by means of it. Of the 92 elements which are thought to exist, the greater number are known, but numbers 43, 61, 75, 85 and 87 are still missing. A previous claim by Dauvillier that he had discovered element 72, which he had named Celtium, is regarded as unjustified by the present investigators.

"A Well-deserved Success"

As a further example of the favourable opinions received respecting *The Chemical Age Year Book* and the journal itself, we publish the following letter, dated January 22, 1923, received from the chief technical assistant to an important chemical firm in the Midlands:—

"I wish to thank you for the copy of your splendid *Year Book and Diary* received this morning. I would like to take this opportunity of paying my humble tribute to your periodical. It embraces a wide variety of subjects, and the feature of devoting a special issue once a month to a particular branch is an admirable one. Further, articles on current topics are much appreciated, and too much attention is not devoted to the purely theoretical side. At the moment commercial relationships require fostering, and as much publicity should be given to industrial matters as you can afford space for. May I again express my appreciation of the perspicacity of the views expressed in your journal, and may I wish it a well-deserved success."

Economic Developments in Turkey

WITH a view to the economic development of the new Turkey (The *European Commercial* states) a company is said to have just been founded by Mr. Leslie Urquhart, with a nominal capital of £250,000, to be increased to £1,000,000 as circumstances demand. No shares will be offered to the public. The principal subscriber is Mr. Leslie Urquhart, president of the Russo-Asiatic Consolidated, Ltd., which well-known enterprise will be the chief shareholder of the new concern. The company's operations will include mining and the production of metals, oils and chemical productions and the building and working of railways, canals, docks, etc. As financial agent of the Turkish Government the undertaking will be in a position to transact other business, the more so as the company will not confine its business activities to European Turkey, but will extend them into Asia Minor. Mr. Urquhart will himself be president of the new company, and the majority of the members of the board of administration will be English.

The Manufacture of Patent Fuels

LECTURING before the Liverpool Section of the Society of Chemical Industry on January 19, Mr. Arthur Grounds reviewed the history of the patent fuel industry, in the course of which he pointed out that certain forms of briquette were in use in China very many years ago. The modern process was established in England in 1846. Mr. Grounds then detailed the qualities necessary from the combustible, transport and manufacturing points of view, and exhibited slides illustrating the process and machinery now in use.

From Week to Week

MR. D. P. WYLLIE, of Daniel Wyllie and Co., fertiliser and sulphuric manufacturers, Ayr, has died, aged 46.

MR. JOHN W. CLARK, of 98, Constitution Street, Leith, is now specialising in lead burning in all its branches.

BRUNNER, MOND AND CO. (CHINA), LTD., have removed to their new building at 41, Szechuen Road, Shanghai.

PROFESSOR C. H. DESCH is recorder of the Chemistry Section of the British Association for the forthcoming Liverpool meeting.

AT CAMBRIDGE, on January 19, the degree of D.Sc. was conferred upon Messrs. C. G. Lamb (Clare) and H. L. Duke (Caius).

THE DEATH occurred suddenly at 44, Lauriston Place, Edinburgh, on Monday, of Mr. Thomas Miller, scientific instrument maker.

DR. RUDOLPH A. PETERS, Fellow of Gonville and Caius College, Cambridge, has been elected to the Whiteley Professorship of Biochemistry.

MR. WALTER BURT has been elected Chairman of the Timber Fireproofing Co., Ltd., in place of the late Sir Richard V. Vassar-Smith.

ACCORDING TO M. Franck, the Belgian Minister for the Colonies, radium can be produced in the Belgian Congo in sufficient quantities to supply the world.

MEMBERS of the managing committee of the Cambridge University pension scheme include Professor Sir W. J. Pope, and Mr. F. Stoakley, of the Chemical Laboratory.

PEMBERTON AND CO., manufacturing chemists, Belfast, announce that they are now carrying on the business of the Grosvenor Chemical Co., Cullingtree Road, Belfast.

MR. THOMAS BELL, an old Tyne wherryman, who was for many years employed by the United Alkali Co., Ltd., died suddenly on January 20 at Walker New Road, South Byker.

IT IS OFFICIALLY ANNOUNCED that Bolckow, Vaughan and Co., Middlesbrough, have acquired an extensive limestone area near Kirkby Stephen, Westmorland, with a view to quarrying limestone on a large scale.

MR. P. H. LOCKHART, rubber manufacturer, of Leicester, has been chosen by the India Rubber Manufacturers' Association to interview the Rubber Association of America with reference to the British rubber restriction scheme.

THE FUNERAL of the late Mr. Andrew Macdonald, senior partner of John Poynter, Son and Macdonalds, chemical manufacturers, who died at Teneriffe recently, took place on Tuesday from 5, Sherbrooke Avenue, Pollokshields.

A DEPUTATION on behalf of the cement industry of Kent to urge the increased use of concrete for roads was received at the Ministry of Transport on Wednesday by Sir H. Maybury, who promised to do what he could to help the industry.

THE MANN LECTURE on "The Relation between Chemical Constitution and Antiseptic Action in the Coal Tar Dyes," by Messrs. T. H. Fairbrother, F.I.C., and A. Renshaw, will be delivered before the Royal Society of Arts, on January 31, at 8 p.m.

A VERDICT of "Accidental Death" was returned at an inquest on an engine-driver named Thompson, who fell from a boiler and sustained fatal injuries last week at the Bromsgrove Mills of Southall Brothers and Barclay, manufacturing chemists, Birmingham.

IN CONNECTION with the death of Dr. George Lunge, Professor of Chemical Technology at the Polytechnikum, Zürich, we understand that Mr. Wilfrid Wyld, consulting chemical engineer, of Leeds, has just rewritten Dr. Lunge's treatise on sulphuric acid.

MR. JOHN SENIOR, one of the five men injured by the explosion of a nitrator at the Huddersfield works of the British Dyestuffs Corporation, Ltd., succumbed to his injuries on January 17. An inquiry held last week was adjourned by the coroner until February 1.

IN REGARD TO the Peruvian Government 5½ per cent. (Salt) Loan of 1909, it is announced that the net receipts for the salt monopoly for the six months ended June 30 last amount to £P.64,456. This is the highest figure which has ever yet been reached in the first half of any year.

AFRICAN GERANIUM OIL production has fallen off considerably during the last two years. In 1919 thirty-four tons of oil were exported, in 1920 only fifteen tons, and in 1921 less than fifteen tons. About 3,000 acres of land, principally in the plain of Mitidja, are under cultivation.

REPRESENTATIVES of teachers in technical institutions have offered to the Standing Joint Committee set up by the Board of Education an abatement of 5 per cent. from their salaries for the financial year beginning April 1 next, subject to their obtaining the approval of the associations they represent.

AT A DINNER of the Labour Co-partnership Association on Wednesday, Dr. Charles Carpenter, president of the South Metropolitan Gas Co., and Mr. G. W. Paton, managing director of Bryant and May, Ltd., bore testimony from personal experience in their business to the success of co-partnership.

EFFORTS ARE BEING MADE by the Medical Research Council to expedite the manufacture on a large scale of the new remedy "insulin" for the treatment of diabetes. It has now been found possible to prepare active insulin by extraction from the pancreas of an animal slaughtered in the ordinary way.

ADDRESSING the Bristol and South Western Counties' Section of the Institute of Chemistry, Mr. R. B. Pilcher emphasised the obligations of chemists towards the Institute and the profession of chemistry. He believed that the profession was capable of supplying leaders both for industry and for public life.

OWING TO his recent indisposition, Mr. F. H. Carr, F.I.C., was unable to read his paper on "The Manufacture of Organic Chemicals" at the meeting of the Northern Polytechnic Institute Chemical Association on Tuesday. Dr. T. J. Drakely read a paper on "Coal Washing," in which he urged the re-introduction of the system of "washing" coal.

ON February 1, Professor I. M. Heilbron delivers the first of two lectures at the Royal Institution on the "Photosynthesis of Plant Products." The Friday evening discourse on February 2 will be delivered by Mr. C. F. Cross on "Fact and Phantasy in Industrial Science," and on February 9 by Sir John Russell, on "Rothamsted and Agricultural Science."

A GROUP of American financiers is in Italy, says the Rome correspondent of the Exchange Telegraph Co., for the purpose of studying the sulphur production of Sicily. The group has had numerous interviews with Government officials and Italian financiers, and it is anticipated that an Italo-American trust will be formed for the entire production and exportation of the sulphur.

TESTS made with the German synthetic drug known as "Bayer 205" were referred to in papers read before the Royal Society of Tropical Medicine and Hygiene last week. It appeared that the drug was very potent in the treatment of sleeping sickness. A preparation made in the Rockefeller Institute, and called "tryparsamide," was also claimed to have given good results in the treatment of the same disease.

PETRI BROTHERS, 39, Lime Street, London, E.C.3, announce that they have converted their business into a private limited company, as from January 1, under the style of Petri Brothers, Ltd., and that their address from January 22 is at 24, Minories, E.1. Their telephone number (Avenue 51) remains unchanged. Mr. P. E. Robert Weiss has joined the firm from January 1 as a director, and the manager, Mr. H. Symonds, is also a director, but in other respects the business will be conducted in the same manner as hitherto.

FRESH EFFORTS are, it is stated, about to be made to induce the Government to assist the Cornish tin mines. A Sub-Committee of the Non-Ferrous Mines Committee, set up by the late Government, failed to obtain a promise of Government assistance from Sir Robert Horne, when Chancellor of the Exchequer, but they hope to approach his successor, Mr. Stanley Baldwin, with greater chance of success. The Labour Party also propose to endeavour to induce the Government to take over the mines and work them as national property in the national interest.

THE SECRETARY of the Canadian Chamber of Commerce in London has forwarded to Sir William Joynson-Hicks, Director of the Overseas Trade Department, a copy of a resolution passed by his council, declaring that that Chamber is strongly of opinion that in order to secure the full benefits of the great efforts and expense of the British Empire Exhibition, 1924, and in the interests of the whole Empire, it should be followed by an annual exhibition of the same nature. It is also suggested that the present British Industries Fair should be enlarged and developed along the lines of the Canadian National Exhibition to achieve this object.

References to Current Literature

British

ESSENTIAL OILS.—Note on the congelation of essential oils. W. J. Sanderson and W. J. Jones. *J.S.C.I.*, January 5, 1923, pp. 1–2T.

BLEACHING.—Bleaching cotton with hypochlorous acid. S. R. Trotman. *J.S.C.I.*, January 5, 1923, pp. 2–3T.

COAL.—Factors influencing the yield of ammonia in the carbonisation of coal. Part II. Dissociation, the influence of water vapour, and the character of the contact materials. R. A. Mott and H. J. Hodsman. *J.S.C.I.*, January 5, 1922, pp. 4–12T.

FORMALDEHYDE.—Preparation of α-trioxymethylene and a new polymeride of formaldehyde. D. L. Hammick and A. R. Boeree. *Chem. Soc. Trans.*, December, 1922, pp. 2738–2740.

RESIDUAL AFFINITY.—Researches on residual affinity and co-ordination. Part XIV. Interactions of metallic salts and dimethyldithiolethylene. G. T. Morgan and W. Ledbury. *Chem. Soc. Trans.*, December, 1922, pp. 2882–2894.

LUBRICATION.—Boundary lubrication and chemical constitution. The optically active carbinols of the formula C_2H_5. CH(OH). C_nH_{2n+1}. I. Doubleday. *Chem. Soc. Trans.*, December, 1922, pp. 2875–2879.

HALOGENATION.—The mechanism of the bromination of phenol in aqueous solution. H. Baines. *Chem. Soc. Trans.*, December, 1922, pp. 2810–2813.

REACTIVITY.—The reactivity of methyl groups in heterocyclic bases. W. H. Mills and J. L. B. Smith. *Chem. Soc. Trans.*, December, 1922, pp. 2724–2737.

RUBBER.—Clay in rubber compounding. E. L. Davies. *Rubber Age*, January, 1923, pp. 544–546.

Determination of true free sulphur and true coefficient of vulcanisation in vulcanised rubber. W. J. Kelly. *Rubber Age*, January, 1923, pp. 563–565.

United States

DYESTUFFS.—Optically active dyes. Part I. A. W. Ingersoll and R. Adams. *J. Amer. Chem. Soc.*, December, 1922, pp. 2930–2937.

HYDROLYSIS.—The acceleration of the hydrolysis of mustard gas by alkaline colloidal solutions. R. E. Wilson, E. W. Fuller and M. O. Schur. *J. Amer. Chem. Soc.*, December, 1922, pp. 2762–2783.

The solubility and specific rates of hydrolysis of mustard gas in water. R. E. Wilson, E. W. Fuller and M. O. Schur. *J. Amer. Chem. Soc.*, December, 1922, pp. 2867–2878.

ANALYSIS.—The separation and determination of sodium and lithium by precipitation from alcoholic perchlorate solution. H. H. Willard and G. F. Smith. *J. Amer. Chem. Soc.*, December, 1922, pp. 2816–2824.

The successive electrometric titration of iron, vanadium and uranium. R. G. Gustavson and C. M. Knudson. *J. Amer. Chem. Soc.*, December, 1922, pp. 2756–2761.

ESTERS.—Preparation of benzyl esters of some high-boiling acids. T. J. Thompson and G. J. Leuck. *J. Amer. Chem. Soc.*, December, 1922, pp. 2894–2896.

ABSORPTION.—Absorption of carbon disulphide vapour by aqueous solutions of sodium trinitride. A. J. Currier and A. W. Browne. *J. Amer. Chem. Soc.*, December, 1922, pp. 2849–2854.

The absorption of carbon monoxide by cuprous ammonium carbonate and formate solutions. A. T. Larson and C. S. Teitsworth. *J. Amer. Chem. Soc.*, December, 1922, pp. 2878–2885.

OILS.—The chemical composition of soya bean oil and sunflower seed oil. W. F. Baughmann and G. S. Jamieson. *J. Amer. Chem. Soc.*, December, 1922, pp. 2947–2957.

CYCLIC COMPOUNDS.—Delta ketonic nitriles and their relation to cyclic compounds. Part II. E. P. Kohler and B. L. Souther. *J. Amer. Chem. Soc.*, December, 1922, pp. 2903–2914.

ELEMENTS.—The thermal ionisation of gaseous elements at high temperatures. A. A. Noyes and H. A. Wilson. *J. Amer. Chem. Soc.*, December, 1922, pp. 2806–2815.

GERMANIUM COMPOUNDS.—Germanium. Part IV. Germanium tetra-iodide. L. M. Dennis and F. E. Hance. *J. Amer. Chem. Soc.*, December, 1922, pp. 2854–2860.

FILMS.—Films. The spreading of liquids and the spreading coefficient. W. D. Harkins and A. Feldman. *J. Amer. Chem. Soc.*, December, 1922, pp. 2665–2685.

French

SILVER COMPOUNDS.—Ammoniacal silver fluoride. Dervin and Olmer. *Compt. rend.*, November 27, 1922, pp. 1058–1061.

SYSTEMS.—The system magnesium chloride-potassium chloride-barium chloride. J. Valentin. *Compt. rend.*, November 27, 1922, pp. 1061–1063.

AMINES.—Tertiary amines derived from benzhydrylamine. M. Sommelet. *Compt. rend.*, December 4, 1922, pp. 1149–1151.

SPECTRO-CHEMISTRY.—Ultraviolet absorption spectra of the isoquinoline alkaloids. Papaverine and its hydrochloride. P. Steiner. *Compt. rend.*, December 4, 1922, pp. 1146–1149.

ALCOHOLS.—Alkyl glycerins. Transformation of vinylalkylcarbinols into alkyl glycerins. R. Delaby. *Compt. rend.*, December 4, 1922, pp. 1152–1154.

ACIDS.—Methylisopyromucic acid and a method of diagnosis of sugar acids. L. J. Simon and A. J. A. Guillaumin. *Compt. rend.*, December 11, 1922, pp. 1208–1211.

PHOSPHORESCENCE.—Phosphorescence and phototropy of some metallic sulphides. J. R. Mourelo. *Monit. Scient.*; Part I, September, 1922, pp. 177–188; Part II., December, 1922, pp. 249–260.

REACTIONS.—Action of sodammonium on aniline and its homologues. M. Picon. *Compt. rend.*, December 11, 1922, pp. 1213–1216.

Syntheses by means of mixed organo-zinc compounds: propylglyoxal. E. E. Blaise. *Compt. rend.*, December 11, 1922, pp. 1216–1218.

SILICA.—Hydrated silica; its use in chemical industry. G. Durocher. *L'Ind. Chim.*, December, 1922, pp. 533–536.

German

COLLOIDS.—Colloid chemistry from the standpoint of electrochemistry. L. Michaelis. *Kolloid Z.*, November, 1922, pp. 246–251.

The colloid chemistry of proteins. W. Pauli. *Kolloid Z.*, November, 1922, pp. 252–256.

Colloid chemistry and photo-chemistry. K. Schaum. *Kolloid Z.*, November, 1922, pp. 258–262.

COLLOIDS. Colloid chemistry and dyeing. R. Haller. *Kolloid Z.*, November, 1922, pp. 295–299.

Colloid chemistry and rubber. R. Weil. *Kolloid Z.*, November, 1922, pp. 303–308.

Colloid chemical problems of the paper and cellulose industry. R. Sieber. *Kolloid Z.*, November, 1922, pp. 308–310.

Colloid chemistry and tanning. E. Stiasny. *Kolloid Z.*, November, 1922, pp. 299–301.

STEREOCHEMISTRY. Stereochemical considerations in inorganic chemistry. Part I. P. Pfeiffer. *Z. angew. Chem.*, December 15, 1922, pp. 703–704.

OZONE. The importance and use of ozone in organic chemistry. C. Räth. *Z. angew. Chem.*, December 26, 1922, pp. 717–719.

METALLOGRAPHY. The scientific principles of the investigation of the noble metals. R. Vogel. *Z. angew. Chem.*, December 19, 1922, pp. 705–708.

DYESTUFFS. New anthraquinone vat dyestuffs. H. Truttwin. *Z. angew Chem.*, December 15, 1922, p. 702.

PIGMENTS. The nature of chrome yellow. J. Milbauer and K. Kohn. *Chem.-Zeit.*, December 21, 1922, pp. 1145–1148.

ANALYSIS. Estimation of lead. Part II. L. W. Winkler. *Z. angew. Chem.*, December 22, 1922, pp. 715–716.

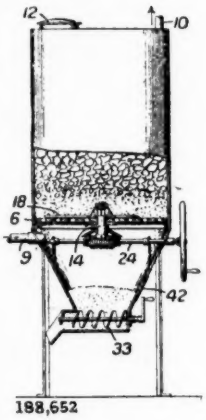
PIGMENTS.—Action of light on painters' colours. Cause and elimination of the non-fastness of lithopone. A. Eibner. *Chem.-Zeit.*, January 4, 1923, pp. 13–16.

Patent Literature

Abstracts of Complete Specifications

188,652. Drying Gases. Nitrogen Corporation, 55, Canal Street, Providence, R.I., U.S.A. Assignees of E. H. Arnold, Coventry, R.I., U.S.A., and W. T. Wakeford, Providence, R.I., U.S.A. International Convention date, November 9, 1921.

The apparatus is more particularly for drying nitrogen and hydrogen used in the synthesis of ammonia. The gases are passed at a pressure of 2–5 lb. per sq. in. through a hygroscopic material which is converted into powder by absorption



188,652

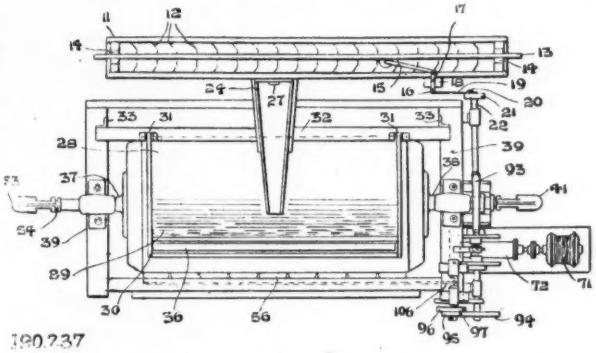
of moisture, and the powder is removed intermittently. The drying chamber contains lime supported on a perforated plate 6, and the gases are introduced through a pipe 9 below the plate. The lime becomes powdered and the powder is withdrawn through the plate 6 by rotating the blades 18 at intervals through the hand gear 24, 14. The powder in the bottom of the chamber prevents the admission of air, and is partly discharged periodically by the hand operated screw 33.

188,662. Basic Calcium Hypochlorites. Chemische Fabrik Griesheim-Elektron, 51, Gutleutstrasse, Frankfurt-on-Main, Germany. International Convention date, November 8, 1921. Addition to 182,927.

Basic calcium hypochlorites are produced by chlorinating calcium hydrate in water. If the chlorination is carried on with precipitation of basic hypochlorite, until the mother liquor contains a minimum proportion of bleaching chlorine, the precipitate consists of dibasic hypochlorite. If the chlorination is continued, the bleaching chlorine in the mother liquor first increases and then decreases to another minimum, and a precipitate of monobasic hypochlorite is obtained. It is thus possible to obtain basic hypochlorites of definite composition, or definite mixtures of basic hypochlorites.

190,237. Tungstic Oxide, Method of and Apparatus for Producing in a Dried and Powdered Condition. The British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2. From the General Electric Co., Schenectady, N.Y., U.S.A. Application date, September 14, 1921.

The washed precipitate of tungstic oxide is mixed with water to form a thin paste, which flows into a trough 11 (shown in plan in the illustration). The mixture is agitated by a series of vanes 12, carried by a reciprocating rod 13, operated by levers 15, 16, 19, which are reciprocated by a rotating shaft 22. The paste flows out through the shoot 24, extending just beyond the central vertical plane of a hollow drying drum 28. The paste is delivered into a recess 29, formed by a longitudinal plate 30, resting on the surface of the drum. The drum is mounted on hollow shafts 38, so that steam may be supplied to the interior to heat the surface and dry the paste. The surface of the drum is preferably enamelled or lined with bakelite. The drum is rotated in such a direction that a film of paste is carried out of the recess 29 in an upward direction, and the paste is dried during rotation and finally removed by a set of brushes 56. The drum and rod 13 are operated by a single motor 71, the former through a shaft 22 and the latter through a worm wheel 93. The brush 56 is reciprocated transversely to the direction of rotation by gearing 95, 96 from the same motor 71. The dried precipitate is collected as a fine powder in a container below.



190,237

190,510. Rubber, Treatment of. C. Reid, 11, Glebe Road, Kilmarnock, Scotland. Application date, July 20, 1921.

The object is to treat rubber in a finely divided condition with gases or fumes. Rubber latex or a rubber solution is projected into the interior of a cone formed of a body of air or gas to which the rubber is to be subjected. The rubber is directed towards the apex of the cone, and the force of the air or gas breaks it up into very fine particles. The solution may be projected into a conical jet of sulphur dioxide, hydrogen sulphide, sulphur chloride, or the like, to produce a vulcanising action. The stream of gas and rubber particles may be directed on to any surface to be coated with rubber. The air or gas may be treated to remove moisture and afterwards heated so that it has a drying effect on the rubber.

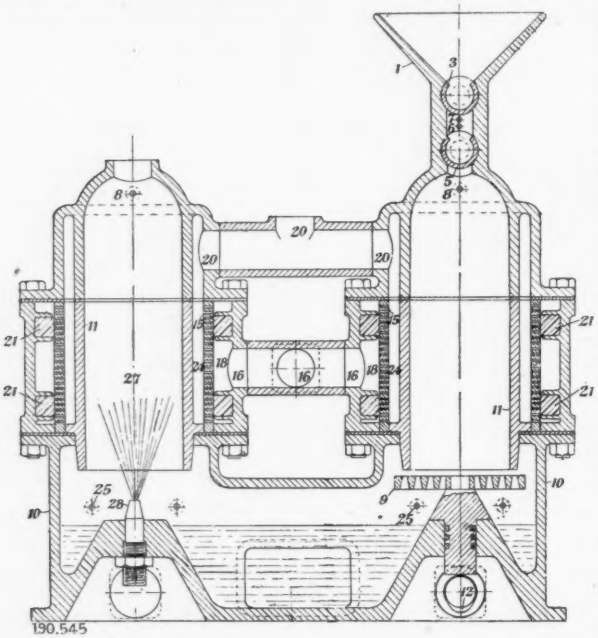
190,516. Pulverising or Disintegrating Machines. Sir E. P. C. Girouard, 1, St. James Street. London, S.W.1., and F. W. S. Jones, 14/16, Cockspur Street, London, S.W.1. Application date, August 23, 1921.

The pulverising or disintegrating machine is of the type in which alternate circular series of pins are arranged perpendicularly on the opposed faces of two concentric discs, which are rotated in opposite directions, or one only is rotated. The material to be treated is fed centrally into the space between the discs and is disintegrated in passing outwards. In these machines the pins are usually secured to the disc by screwing them into sockets, but in the present invention the pins are secured to the discs by electric welding. The current is passed through the pin and disc, and the pin momentarily separated from the disc to strike the arc. The pin is then returned to the disc to effect the weld. The pins are preferably formed of oblong or similar section, the major axis of which is tangential to the circular path of the pin.

190,545. Gas Generators. F. Umpleby and H. Powers, 24, Tufton Street, Silsden, near Keighley, Yorkshire. Application date, September 24, 1921.

The apparatus is for gasifying carbonaceous materials such as coal, coke, charcoal, tar, vegetable matter, peat and/or mineral or vegetable oils, by heat derived from surface combustion. Solid carbonaceous material is powdered and supplied from a hopper 1 to the producer 11. The valve 3 rotates so as to transfer its charge to the valve 5, and then returns to its filling position. A valve 6 controlling a passage from the producer is then opened to equalise the pressure on the two sides of the valve 5, and this valve is then rotated to transfer the charge to the producer 11. The valve 7 communicating with the atmosphere is then opened to equalise the pressures on the two sides of the valve 3 before its next movement. This arrangement of valves avoids loss of gas when the producer is working above atmospheric pressure. If the carbonaceous material is in the form of fine powder, liquid, or colloidal mixtures, it is supplied through the nozzle 8. The producer is heated externally by surface combustion, and the carbonaceous material may be completely gasified so that

only ashes and clinker reach the grate 9. In treating granular material, the producer 11 may become filled, and the grate 9 may be agitated by a cam 12 so that the waste material is gradually discharged into a tank 10. The heating mixture of gas and air is supplied through an opening 16 to an annular chamber 18 surrounding a porous cylinder 15. The gas burns at the inner surface of this cylinder in the space 24, and the combustion products are discharged through the conduit 20. Heat may be extracted from the cylinder 15 by means of a number of solid plugs 21 of metal of high conductivity, such as aluminium, distributed over the surface of the cylinder. After the apparatus has started working, part of the gas generated may be supplied to the surface combustion apparatus. The tube 15 may be composed of a granular highly refractory material, such as electrically fused alumina or a refractory



iron or steel alloy. Alternately the tube 15 may be constructed of layers of wire gauze or expanded metal, or a combination of highly refractory cement and metallic alloy. Steam may be admitted to the space below the grate through the nozzle 25, and passes upwards through the carbonaceous material in the producer to form water-gas. The carbonaceous material may be mixed with calcareous material to increase the production of carbon dioxide, and subsequently carbon monoxide. The calcareous material only may be supplied from the hopper 1 and liquid carbonaceous material through the nozzle 8. Alternatively, the calcareous material may be supplied from a hopper 1, and the gas evolved from it passes downwards through the grate 9, and thence, together with water vapour, to an enriching apparatus 27. Powdered liquid or colloidal carbonaceous material is injected by the nozzle 28 into the space 27, where it reacts with the carbon dioxide and steam to produce a combustible gaseous mixture.

190,553. Petroleum and Liquid Hydrocarbons, Treatment of. A. E. Dunstan and E. G. P. Remfry, Meadhurst, Cadbury Road, Sunbury-on-Thames. Application date, September 28, 1921.

The process is for desulphurising or decolorising petroleum and other hydrocarbons, and the object is to economise in the quantity of absorbent materials required. The hydrocarbon is treated in succession with fuller's earth or floridin, and another colloidal gel such as bauxite or alumina. The mineral oil is dried and treated with freshly roasted floridin, which is still warm. The floridin should be roasted at a temperature of 250° –300° C., and should be capable of passing through a 40-mesh screen but not an 80-mesh screen. The oil is then treated with bauxite which has been roasted at 600° C. for one hour, and is still warm. It is found that when treating kerosene distillate containing 0·2 per cent. of sulphur, ⅛ lb. of bauxite per gallon of oil was necessary to effect desulphurisation after a preliminary floridin treatment, but that 1 lb. of bauxite per gallon was necessary when the preliminary floridin treatment was not employed.

190,688. Anhydrous Metal Chlorides, Manufacture of. B. H. Jacobson, 1324, Quarriere Street, Charlestown, W.Va., U.S.A. International Convention date, May 31, 1922. Addition to 181,385. (See The Chemical Age, Vol. VII, p. 249.)

In the manufacture of anhydrous aluminium chloride by the use of chlorine with a small quantity of bromine or a bromide as described in specification 181,385 (above) a diluent such as sodium chloride or bromide is added so that the mixture of salts may be melted at atmospheric pressure. Aluminium chloride normally sublimes at 183° C., but may be liquefied at this temperature under a pressure of 40 lb. per square inch. It is desirable to work at a lower temperature to avoid excessive corrosion of the reaction vessel, and it is found that this may be effected without solidification of the aluminium chloride by adding 15–30 per cent. of sodium chloride, giving a mixture which melts at 125° C. under normal pressure. This mixture has the further advantage that it is capable of dissolving small quantities of bromine. In an example, a mixture of aluminium chloride 200 parts and sodium chloride 30 parts is melted, and metallic aluminium 15 parts and bromide 3 parts then added, forming aluminium bromide. Chlorine is then passed through the mixture, converting the aluminium bromide into chloride and liberating the bromine, which reacts with a further quantity of aluminium. The molten mixture is partly drawn off at intervals, and additional quantities of metallic aluminium and sodium chloride are added. Loss of bromine must also be made good. Alternatively, the temperature may be raised to 200° C., and the volatilised chlorides condensed, yielding a higher proportion of aluminium chloride. The presence of sodium chloride does not affect the use of aluminium chloride in organic syntheses, but renders it less hygroscopic. Sodium bromide may be used instead of sodium chloride, in which case bromine is unnecessary.

International Specifications not yet Accepted

188,666. Drying and Separating Gases. Algemeene Norit Maatschappij, 2, Den Texstraat, Amsterdam. International Convention date, November 14, 1921.

The process is applicable for separating light and heavy hydrocarbons or for freeing hydrogen from impurities, such as hydrocarbons or carbon dioxide. The gas is passed through a series of containers containing active carbon of vegetable origin which has previously been dehydrated by ignition or by heating *in vacuo*. The containers may be cooled to remove heat of adsorption, and the cooled gas may be used for cooling the incoming moist gas. The gas should preferably be compressed or cooled to 0°–5° C. When one container becomes exhausted the carbon may be reactivated by passing hot inert gas into it through a perforated tube.

188,667. Treating Liquids with Gases. Algemeene Norit Maatschappij, 2, Den Texstraat, Amsterdam. International Convention date, November 14, 1921.

The process is applicable for bleaching liquids, oxidising drying and semi-drying oils, oxidising mineral oils to convert them into fatty acids and other products, and purifying and sterilising water or other liquids with chlorine. The liquid and gas to be treated are brought into contact with one another in the presence of activated carbon obtained from vegetable matter in such a manner that its structure is retained. A mixture of the liquid and carbon may be treated with the gas, or the liquid and gas may be passed through a column of carbon in counter-current, or the gas may be adsorbed in the carbon and then treated with the liquid. The carbon is activated by ignition or by heating in a vacuum. The gas may be adsorbed in the carbon under pressure at a low temperature, or by employing a solution of the gas in the liquid to be treated or in another liquid.

189,091 and 189,107. Catalytic Oxidation of Hydrocarbons. Barrett Co., 40, Rector Street, New York. (Assignees of A. E. Craver, 163, Anderson Place, Buffalo, N.Y., U.S.A.) International Convention dates, November 14 and November 18, 1921.

189,091.—The process is particularly suitable for the oxidation of toluene to benzaldehyde, but is applicable generally to

aromatic hydrocarbons containing a methyl group. The vapour is mixed with air or oxygen and passed over a catalyst consisting of a compound of a metal of the fifth or sixth periodic group mixed with another metal compound. In the particular case mentioned, the catalyst may be a mixture of uranium and molybdenum oxides with or without copper oxide. A carrier such as pumice or asbestos may be used and may be soaked in a solution of organic salts of the metals or a suspension of the oxides or hydroxides and then ignited. Xylenes, pseudocumene, mesitylene and halogenated derivatives may also be treated by the process.

189,107.—The process is similar to that described in 189,091 above. The catalyst specified is an oxide of a metal of the fifth or sixth periodic group, other than vanadium. Examples are given in which *o*-xylene is converted into *o*-toluic aldehyde by passing over molybdenum oxide; *m*- and *p*-xylenes are converted into *m*- and *p*-toluic aldehydes by passing over uranium oxide; pseudocumene is converted into 1·2-dimethyl-4-benzaldehyde by passing over tungsten oxide; mesitylene is converted into 1·3-dimethyl-5-benzaldehyde by passing over uranium oxide; *p*-cymene is converted into *p*-toluic aldehyde by passing over uranium oxide; and *o*-chlortoluene is converted into *o*-chlorbenzaldehyde by passing over tantalum oxide.

189,114. Artificial Silk. Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Holland. (Assignees of J. R. N. van Kregten, Arnhem, Holland.) International Convention date, November 18, 1921.

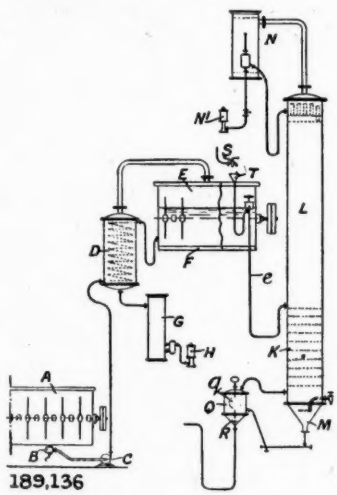
Viscose and other cellulose solutions are emulsified with paraffin, which is not soluble in the solution, and then allowed to stand. A paraffin layer separates carrying with it suspended impurities and part of the resinous and colouring matter, leaving a purified viscose. The separation may be effected by centrifugal means.

189,132. Lead Monoxide. T. Goldschmidt Akt.-Ges., 18, Salkenbergsweg, Essen, Germany. International Convention date, November 15, 1921.

Lead monoxide is obtained by volatilising and oxidising metallic lead, litharge, lead carbonate or sulphide, and then separating the oxide by filtration or washing.

189,136. Absolute Alcohol. E Barbet et Fils et Cie., 5, Rue de l'Echelle, Paris. International Convention date, November 15, 1921.

Alcohol of 95-96° Gay-Lussac is mixed with a dehydrating agent such as powdered quicklime and distilled to obtain the alcohol. The remaining mixture is diluted with water and treated in a rectifier to obtain 96° alcohol, which is again



189,136

dehydrated. The mixture of alcohol and lime passes from a mixer A to a heater D and a continuous steam-jacketed still E. About 75 per cent. of the alcohol is distilled and condensed in the heater D and cooler G, and the remaining mixture passes through a pipe *e* to a continuous exhauster KL. Steam is injected into the lower part, and the alcohol driven into a reflux N, where it is rectified to 96°. The lime collecting in the base M passes to an extractor Q provided with a float valve. Other dehydrating agents, such as fused calcium chloride, anhydrous potassium carbonate, anhydrous sodium or copper sulphate, or anhydrous sodium acetate, may be used. A simpler form of the apparatus dispensing with the use of a dehydrating agent is also described.

Latest Notifications.

191,694. Furnaces for powdered combustible. Powdered Fuel Plant Co., Ltd. Jan. 14, 1922.

191,728. Apparatus for measuring or transmitting to a distance values of physical or chemical quantities. Roucka, E. January 10, 1922.

191,729. Arrangements for measuring automatically any kind of variable physical or chemical values from a distance. Roucka, E. January 11, 1922.

191,735. Apparatus for measuring and transmitting values of any kind of varying physical or chemical quantities or qualities. Roucka, E. January 12, 1922.

191,741. Recovery of ammonia from gases containing the same. Industrial Research, Ltd. January 10, 1922.

Specifications Accepted, with Date of Application

174,069. Rotary distilling drums. Maschinenfabrik Augsburg-Nurnberg Akt.-Ges. January 17, 1921.

176,354. Calcium hydride, Electric furnace for the production of. A. Kieselwalter. March 3, 1921.

182,446. Basic salicylate of alumina, Process for the preparation of. Soc. Chimique des Usines du Rhone. June 28, 1921.

184,760. Distilling and concentrating liquids, Process of. C. H. Caspar. August 17, 1921.

189,114. Purifying solutions of viscose and similar solutions of cellulose, Method of. Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek. November 18, 1921.

191,119. Gasification of coal, Apparatus for. E. J. and J. Pearson, Ltd., and J. C. Deeley. June 20, 1922.

191,129. Superphosphates and manure, Manufacture of. L. Adelantado. October 1, 1921.

191,132. Liquid into contact with gases, Apparatus for bringing. H. B. P. Humphries. October 3, 1921.

191,208. Grinding, crushing and mixing mills. J. Wass. October 25, 1921.

191,215. Oxide of barium, Process of manufacturing. W. von Dieterich. October 31, 1921.

191,233. Dihydro-isoquinoline, Manufacture of derivatives of. O. Y. Imray. (*Soc. of Chemical Industry in Basle.*) November 16, 1921.

191,274. Grinding or disintegrating machines. H. N. Oswald. December 24, 1921.

191,295. Tar and the like, Distillation of. S. W. A. Wikner and Newcastle-on-Tyne and Gateshead Gas Co. January 27, 1922.

191,305. Azo-dyestuffs, Manufacture of. O. Y. Imray. (*Soc. of Chemical Industry in Basle.*) February 16, 1922.

191,318. Hydrocarbon oils, Process for converting into oils of lower boiling point. R. Cross. March 21, 1922.

Applications for Patents

Alcock, H. E., and Laporte, Ltd., B. Manufacture of phosphoric acid. 1673. January 18.

Appleby, E. G. Gas producers, retorts, etc. 1802. January 19.

Bhopal Produce Trust, Ltd. Recovery of calcium oxalate, etc., from trees. 1774. January 19. (British India, July 24, 1922.)

—— Processes for obtaining oxalic acid or its salts. 1775. January 19. (British India, November 25, 1922.)

British Dyestuffs Corporation, Ltd. Frank, G. H., Green, A. G., and Saunders, K. H. Manufacture of azo dyestuffs. 1314. January 15.

Chief Consolidated Mining Co. Treatment of siliceous ores. 1356. January 15. (United States, August 5, 1922.)

Clayton Aniline Co., Ltd., and Grundy, J. G. Treatment of acetyl cellulose in alkaline liquids. 1674. January 18.

Frink, R. L. Producing alumina and glass-making salts. 1301. January 15.

Hertz, G. L. Cooling electrodes of X-ray tubes. 1572. January 17.

Heyl, G. E. Distillation of oil and coal shales for formation of road material, etc. 1410. January 16.

International Yeast Co., Ltd. Production of yeast. 1660. January 18. (United States, January 19, 1922.)

Lunden, H., and Nobel, L. A. Process for removing nitrogen from metal and alloys. 1666. January 18.

Montgomery, W. A. Producing emulsions. 1457. January 16.

Pease, E. L. Manufacture of calcium carbide and fertilising materials. 1678. January 18.

Southern, F. G. Calcination of limestone, roasting ores, etc. 1867. January 20.

Waldberg, A. Electro-deposition of metals. 1424. January 16. (France, January 19, '22.)

Market Report and Current Prices

Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, *and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.*

London, January 24, 1923.

TRADE has been again quite active this week and a fair volume of business has been transacted. Prices in most cases are very firm with an upward tendency.

The export position is without change and the volume of business transacted continues to expand.

General Chemicals

ACETONE.—A firm position is maintained, and there is very little sight supplies available; price remains firm.

ACID ACETIC has again slightly advanced and stocks on the spot are extremely small.

ACID CITRIC is steady but only a small volume of business is passing.

ACID FORMIC has a still firmer tendency and the demand is moderate.

ACID LACTIC is in fair request without change in value.

ACID OXALIC is in brisk demand but there is a slight tendency to shade the price.

ACID TARTARIC is fairly firm but the demand is only poor.

ARSENIC.—Quotations are still unchanged and supplies are difficult to obtain for anything like near delivery; there is still a brisk demand on export account.

BARIUM CHLORIDE is still more active but price unchanged.

CREAM OF TARTAR continues stagnant, but with the slightest increase in the demand, price would instantly respond.

COPPER SULPHATE is nominally without change and there is only a small inquiry on the market.

FORMALDEHYDE is again firmer and supplies very short.

LEAD ACETATE is inclined to harden and the demand is good.

METHYL ALCOHOL is unchanged and premiums are paid for near delivery.

POTASSIUM CARBONATE is unchanged.

POTASSIUM CAUSTIC is neglected and in buyers' favour.

POTASSIUM PERMANGANATE maintains its improvement and is in brisk request.

POTASSIUM PRUSSIATE continues scarce and firm and a good business has been done for forward.

SODIUM ACETATE is steady and price well maintained.

SODIUM HYPOSULPHITE has been in better request at makers' figures.

SODIUM NITRITE is fairly active and price is steady.

SODIUM PRUSSIATE.—There is a slight increase in the inquiry and makers maintain their quotations.

ZINC OXIDE.—Scarce and firm.

Pharmaceutical Chemicals

ACID LACTIC 1·21.—The fresh arrivals have slightly eased the spot market, but the undertone remains firm.

BROMIDES.—The movement in the Continental exchanges and consequent realisation of stocks manufactured on the old basis has had a somewhat unsettling effect. A few cheap parcels of Potassium are being offered at what would appear to be bargain prices.

CORROSIVE SUBLIMATE is slightly easier, the available supplies exceeding the demand.

HEXAMINE has advanced sharply and a considerable business has been done. Makers are fully sold for some time ahead, and owing to delay in obtaining delivery, orders are difficult to execute even at the higher level.

SODA SALICYLATE is higher on the week. An exceptionally fine quality in the form of physiologically pure Needle Crystals has been placed on the market by French manufacturers.

VANILLIN is rather weak again, English makers competing keenly for all orders. The Continental makers decline to follow present prices except for export business.

Coal Tar Intermediates

Business continues fairly quiet, but a certain number of inquiries and orders have been received.

ALPHA NAPHTHOL.—A small home business is in the market.

ALPHA NAPHTHYLAMINE is the turn easier.

ANILINE OIL AND SALT.—Inquiries have been received, both on home and export account.

BENZIDINE BASE is without special feature.

BETA NAPHTHOL has been interesting both for home and export.

BETA NAPHTHYLAMINE is a fair home trade.

DIMETHYLANILINE is unchanged.

" G " SALT.—Some home orders are in the market.

" H " ACID is in demand.

NITRO BENZOL.—The usual regular orders have been received.

NITRO TOLUENE has been demanded for export.

PICRIC ACID.—Foreign buyers seem interested.

" R " SALT is in demand for home consumption.

RESORCIN is firm, with stocks short.

Coal Tar Products

With the exception of benzol and naphtha, prices for coal tar products are very firm, and have an upward tendency.

90% BENZOL is weak, and is worth about 1s. 6d. to 1s. 7d. per gallon, on rails, in the North, and about 1s. 10d. to 1s. 11d. per gallon in London.

PURE BENZOL is easy at about 2s. per gallon in the North, and about 2s. 4d. to 2s. 6d. per gallon in London.

CREOSOTE OIL keeps very strong, and is scarce for prompt delivery. It is worth about 7¾d. per gallon in the North, and from 8d. to 8¼d. per gallon in the South.

CRESYLIC ACID is steady at about 1s. 9d. per gallon for the dark quality 95/97%, while the pale quality 97/99% is quoted at 1s. 11d. to 2s. per gallon.

SOLVENT NAPHTHA is weak, with little demand, and is worth about 1s. 7d. per gallon in the North, while in London the price is about 1s. 11d. to 2s. per gallon.

HEAVY NAPHTHA has a poor demand, and is worth about 1s. 6d. per gallon on rails.

NAPHTHALENE has a rather better inquiry over April/June. Crude and Whizzed qualities with lower melting points are worth from about £7 to £8 per ton, while Hot Pressed is worth £9 10s. to £10 per ton.

PITCH remains firm, and prices are still moving upwards. To-day's quotations are: London 145s., East Coast 142s. 6d., West Coast 140s.–142s. 6d.

Sulphate of Ammonia

The position is unchanged.

Current Prices

General Chemicals

	Per	£	s.	d.		£	s.	d.
Acetic anhydride	lb.	0	1	4	to	0	1	6
Acetone oil	ton	90	0	0	to	95	0	0
Acetone, pure	ton	130	0	0	to	135	0	0
Acid, Acetic, glacial, 99–100%	ton	67	0	0	to	68	0	0
Acetic, 80% pure	ton	45	0	0	to	46	0	0
Arsenic, liquid, 2000 s.g.	ton	100	0	0	to	105	0	0
Boric, cryst.	ton	55	0	0	to	60	0	0
Carbolic, cryst. 39–40%	lb.	0	0	7	to	0	0	7½
Citric	lb.	0	1	9	to	0	1	10
Formic, 80%	ton	50	0	0	to	51	0	0
Hydrofluoric	lb.	0	0	7½	to	0	0	8½
Lactic, 50 vol.	ton	41	0	0	to	43	0	0
Lactic, 60 vol.	ton	43	0	0	to	44	0	0
Nitric, 80 Tw.	ton	27	0	0	to	29	0	0
Oxalic	lb.	0	0	7	to	0	0	7½
Phosphoric, 1.5	ton	40	0	0	to	42	0	0
Pyrogallic, cryst.	lb.	0	5	9	to	0	6	0
Salicylic, Technical	lb.	0	1	2	to	0	1	4
Sulphuric, 92–93%	ton	6	10	0	to	7	10	0
Tannic, commercial	lb.	0	2	3	to	0	2	9
Tartaric	lb.	0	1	2½	to	0	1	3

	Per	£	s.	d.		£	s.	d.
Alum, lump	ton	13	0	0	to	13	10	0
Alum, chrome	ton	28	0	0	to	29	0	0
Alumino ferric	ton	9	0	0	to	9	5	0
Aluminium, sulphate, 14–15%	ton	10	10	0	to	11	0	0
Aluminium, sulphate, 17–18%	ton	11	10	0	to	12	0	0
Ammonia, anhydrous	lb.	0	1	6	to	0	1	8
Ammonia, .880	ton	32	0	0	to	34	0	0
Ammonia, .920	ton	22	0	0	to	24	0	0
Ammonia, carbonate	lb.	0	0	4	to	0	0	4½
Ammonia, chloride	ton	50	0	0	to	55	0	0
Ammonia, muriate (galvanisers)	ton	35	0	0	to	37	10	0
Ammonia, nitrate (pure)	ton	35	0	0	to	40	0	0
Ammonia, phosphate	ton	65	0	0	to	68	0	0
Ammonia, sulphocyanide, com'l, 90%	lb.	0	1	1	to	0	1	3
Amyl acetate	ton	175	0	0	to	185	0	0
Arsenic, white, powdered	ton	70	0	0	to	75	0	0
Barium, carbonate, Witherite	ton	5	0	0	to	6	0	0
Barium carbonate, Precip.	ton	15	0	0	to	16	0	0
Barium, Chlorate	ton	65	0	0	to	70	0	0
Barium Chloride	ton	17	10	0	to	18	0	0
Nitrate	ton	33	0	0	to	35	0	0
Sulphate, blanc fixe, dry	ton	20	10	0	to	21	0	0
Sulphate, blanc fixe, pulp	ton	10	5	0	to	10	10	0
Sulphocyanide, 95%	lb.	0	1	0	to	0	1	1
Bleaching powder, 35–37%	ton	11	0	0	to		—	
Borax crystals	ton	28	0	0	to	32	0	0
Calcium acetate, Brown	ton	12	10	0	to	13	10	0
" " Grey	ton	17	10	0	to	18	0	0
Calcium Carbide	ton	16	0	0	to	17	0	0
Chloride	ton	6	0	0	to	7	0	0
Carbon bisulphide	ton	35	0	0	to	40	0	0
Casein technical	ton	98	0	0	to	105	0	0
Cerium oxalate	lb.	0	3	0	to	0	3	6
Chromium acetate	lb.	0	1	1	to	0	1	3
Cobalt acetate	lb.	0	6	0	to	0	6	6
Oxide, black	lb	0	9	6	to	0	10	0
Copper chloride	lb.	0	1	2	to	0	1	3
Sulphate	ton	27	10	0	to	28	10	0
Cream Tartar, 98–100%	ton	95	0	0	to	97	10	0
Epsom salts (*see* Magnesium sulphate)								
Formaldehyde, 40% vol.	ton	90	0	0	to	95	0	0
Formusol (Rongalite)	lb.	0	2	2	to	0	2	3
Glauber salts, commercial	ton	5	0	0	to	5	10	0
Glycerin, crude	ton	65	0	0	to	67	10	0
Hydrogen peroxide, 12 vols.	gal.	0	2	3	to	0	2	4
Iron perchloride	ton	30	0	0	to	32	0	0
Iron sulphate (Copperas)	ton	3	10	0	to	4	0	0
Lead acetate, white	ton	41	0	0	to	43	0	0
Carbonate (White Lead)	ton	38	0	0	to	40	0	0
Nitrate	ton	44	10	0	to	45	0	0
Litharge	ton	35	10	0	to	36	0	0
Lithopone, 30%	ton	22	10	0	to	23	10	0
Magnesium chloride	ton	5	10	0	to	6	0	0
Carbonate, light	cwt.	2	10	0	to	2	15	0
Sulphate (Epsom salts commercial)	ton	6	10	0	to	7	0	0
Sulphate (Druggists')	ton	10	0	0	to	11	0	0
Manganese Borate, commercial	ton	65	0	0	to	75	0	0
Sulphate	ton	58	0	0	to	60	0	0
Methyl acetone	ton	70	0	0	to	75	0	0
Alcohol, 1% acetone	ton	105	0	0	to	110	0	0
Nickel sulphate, single salt	ton	45	0	0	to	46	0	0
Ammonium sulphate, double salt	ton	45	0	0	to	46	0	0
Potash, Caustic	ton	32	0	0	to	33	0	0
Potassium bichromate	lb.	0	0	6	to	0	0	6½
Carbonate, 90%	ton	30	0	0	to	31	0	0
Chloride, 80%	ton	9	10	0	to	10	10	0
Chlorate	lb.	0	0	4½	to	0	0	4½
Metabisulphite, 50–52%	ton	84	0	0	to	90	0	0
Nitrate, refined	ton	43	0	0	to	45	0	0
Permanganate	lb.	0	0	9	to	0	0	9½
Prussiate, red	lb.	0	4	3	to	0	4	6
Prussiate, yellow	lb	0	1	6½	to	0	1	7½
Sulphate, 90%	ton	12	10	0	to	13	10	0
Salammoniac, firsts	cwt.	3	3	0	to		—	
Seconds	cwt.	3	0	0	to		—	
Sodium acetate	ton	24	10	0	to	24	15	0
Arseniate, 45%	ton	40	0	0	to	42	0	0
Bicarbonate	ton	10	10	0	to	11	0	0
Bichromate	lb.	0	0	4½	to	0	0	4½
Bisulphite 60–62%	ton	21	0	0	to	23	0	0
Chlorate	lb.	0	0	3½	to	0	0	4
Caustic, 70%	ton	19	10	0	to	20	0	0
Caustic, 76%	ton	20	10	0	to	21	0	0
Hydrosulphite, powder	lb.	0	1	6	to	0	1	7
Hyposulphite, commercial	ton	10	10	0	to	11	0	0
Nitrite, 96–98%	ton	29	10	0	to	30	0	0
Phosphate, crystal	ton	16	0	0	to	16	10	0

	Per	£	s.	d.		£	s.	d.
Perborate	lb.	0	0	11	to	0	1	0
Sodium Prussiate	lb.	0	0	10½	to	0	0	11
Sulphide, crystals	ton	10	10	0	to	11	0	0
Sulphide, solid, 60–62%	ton	16	10	0	to	17	10	0
Sulphite, cryst.	ton	12	10	0	to	13	0	0
Strontium carbonate	ton	55	0	0	to	60	0	0
Strontium Nitrate	ton	40	0	0	to	42	0	0
Strontium Sulphate, white	ton	6	10	0	to	7	10	0
Sulphur chloride	ton	25	0	0	to	27	10	0
Sulphur, Flowers	ton	11	10	0	to	12	10	0
Roll	ton	11	0	0	to	12	0	0
Tartar emetic	lb.	0	1	3	to	0	1	4
Tin perchloride, 33%	lb.	0	1	2	to	0	1	4
Perchloride, solid	lb.	0	1	5	to	0	1	7
Protochloride (tin crystals)	lb.	0	1	4	to	0	1	5
Zinc chloride 102° Tw.	ton	21	0	0	to	22	10	0
Chloride, solid, 96–98%	ton	25	0	0	to	30	0	0
Oxide, 99%	ton	40	0	0	to	42	0	0
Dust, 90%	ton	45	0	0	to	47	10	0
Sulphate	ton	16	10	0	to	17	10	0

Pharmaceutical Chemicals

Acetyl salicylic acid	lb.	0	2	10	to	0	3	0
Acetanilid	lb.	0	1	4	to	0	1	6
Acid, Gallic, pure	lb.	0	3	0	to	0	3	3
Lactic, 1.21	lb.	0	2	9	to	0	3	0
Salicylic, B.P.	lb.	0	1	5	to	0	1	7
Tannic, leviss	lb.	0	3	4	to	0	3	6
Amidol	lb.	0	8	6	to	0	8	9
Amidopyrin	lb.	0	14	6	to	0	15	0
Ammon ichthosulphonate	lb.	0	2	0	to	0	2	3
Barbitone	lb.	0	12	6	to	0	13	6
Beta naphthol resublimed	lb.	0	1	9	to	0	2	0
Bromide of ammonia	lb.	0	0	8	to	0	0	8½
Potash	lb.	0	0	7	to	0	0	7½
Soda	lb.	0	0	7½	to	0	0	8
Caffeine, pure	lb.	0	12	0	to	0	12	3
Calcium glycerophosphate	lb.	0	5	6	to	0	6	0
Calcium lactate	lb.	0	2	0	to	0	2	3
Calomel	lb.	0	4	9	to	0	5	0
Chloral hydrate	lb.	0	4	3	to	0	4	6
Cocaine alkaloid	oz.	0	18	6	to	0	19	0
Cocain hydrochloride	oz.	0	15	0	to	0	15	6
Corrosive sublimate	lb.	0	4	3	to	0	4	6
Eucalyptus oil, B.P. (70–75% eucalyptol)	lb.	0	1	7	to	0	1	7½
B.P. (75–80% eucalyptol)	lb.	0	1	8	to	0	1	8½
Guaiacol carbonate	lb.	0	8	0	to	0	8	3
Liquid	lb.	0	9	0	to	0	9	6
Pure crystals	lb.	0	10	0	to	0	10	6
Hexamine	lb.	0	3	6	to	0	3	9
Hydroquinone	lb.	0	3	3	to	0	3	6
Lanoline anhydrous	lb.	0	0	7½	to	0	0	8
Lecithin ex ovo	lb.	0	18	6	to	1	0	0
Lithia carbonate	lb.	0	9	6	to	0	10	0
Methyl salicylate	lb.	0	2	0	to	0	2	3
Metol	b.	0	10	0	to	0	10	6
Milk sugar	cwt.	4	17	6	to	5	2	6
Paraldehyde	lb.	0	1	4	to	0	1	6
Phenacetin	lb.	0	4	10	to	0	5	0
Phenazone	lb.	0	6	9	to	0	7	0
Phenolphthalein	lb.	0	5	0	to	0	5	3
Potassium sulpho guaiacolate	lb.	0	5	0	to	0	5	3
Quinine sulphate, B.P.	oz.	0	2	3			—	
Resorcine, medicinal	lb.	0	5	6	to	0	5	9
Salicylate of soda powder	lb.	0	2	0	to	0	2	3
Crystals	lb.	0	2	1	to	0	2	4
Salol	lb.	0	2	3	to	0	2	6
Soda Benzoate	lb.	0	2	0	to	0	2	3
Sulphonal	lb.	0	13	6	to	0	14	0
Terpene hydrate	lb.	0	1	9	to	0	2	0
Theobromine, pure	lb.	0	12	0	to	0	12	6
" soda salicylate	lb.	0	8	6	to	0	9	0
Vanillin	lb.	1	2	0	to	1	3	0

Coal Tar Intermediates, &c.

Alphanaphthol, crude	lb.	0	2	0	to	0	2	3
Alphanaphthol, refined	lb.	0	2	6	to	0	2	9
Alphanaphthylamine	lb.	0	1	6	to	0	1	7
Aniline oil, drums extra	lb.	0	0	9½	to	0	0	10
Aniline salts	lb.	0	0	9½	to	0	0	10
Anthracene, 40–50%	unit	0	0	8½	to	0	0	9
Benzaldehyde (free of chlorine)	lb.	0	3	0	to	0	3	3
Benzidine, base	lb.	0	5	0	to	0	5	3
Benzidine, sulphate	lb.	0	3	9	to	0	4	0
Benzoic acid	lb.	0	2	0	to	0	2	3
Benzyl chloride, technical	lb.	0	2	0	to	0	2	3

	Per	£	s.	d.		£	s.	d.
Betanaphthol	lb.	0	1	2½	to	0	1	3
Betanaphthylamine, technical	lb.	0	4	0	to	0	4	3
Croceine Acid, 100% basis	lb.	0	3	3	to	0	3	6
Dichlorbenzol	lb.	0	0	9	to	0	0	10
Diethylaniline	lb.	0	4	6	to	0	4	9
Dinitrobenzol	lb.	0	1	1	to	0	1	2
Dinitrochlorbenzol	lb.	0	0	11	to	0	1	0
Dinitronaphthalene	lb.	0	1	4	to	0	1	5
Dinitrotoluol	lb.	0	1	4	to	0	1	5
Dinitrophenol	lb.	0	1	7	to	0	1	9
Dimethylaniline	lb.	0	2	6	to	0	2	9
Diphenylamine	lb.	0	3	9	to	0	4	0
H-Acid	lb.	0	5	0	to	0	5	3
Metaphenylenediamine	lb.	0	4	0	to	0	4	3
Monochlorbenzol	lb.	0	0	10	to	0	1	0
Metanilic Acid	lb.	0	5	9	to	0	6	0
Metatoluylenediamine	lb.	0	4	0	to	0	4	3
Monosulphonic Acid (2.7)	lb.	0	5	6	to	0	6	0
Naphthionic acid, crude	lb.	0	2	3	to	0	2	6
Naphthionate of Soda	lb.	0	2	6	to	0	2	9
Naphthylamin-di-sulphonic-acid	lb	0	4	0	to	0	4	3
Neville Winther Acid	lb.	0	7	9	to	0	8	0
Nitrobenzol	lb.	0	0	8	to	0	0	8½
Nitronaphthalene	lb.	0	1	0	to	0	1	1
Nitrotoluol	lb.	0	0	8	to	0	0	9
Orthoamidophenol, base	lb.	0	12	0	to	0	12	6
Orthodichlorbenzol	lb.	0	1	0	to	0	1	1
Orthotoluidine	lb.	0	0	10	to	0	0	11
Orthonitrotoluol	lb.	0	0	3	to	0	0	4
Para-amidophenol, base	lb.	0	8	6	to	0	9	0
Para-amidophenol, hydrochlor	lb.	0	7	6	to	0	8	0
Paradichlorbenzol	lb.	0	0	6	to	0	0	7
Paranitraniline	lb.	0	3	0	to	0	3	3
Paranitrophenol	lb.	0	2	3	to	0	2	6
Paranitrotoluol	lb.	0	2	9	to	0	3	0
Paraphenylenediamine, distilled	lb.	0	11	6	to	0	11	9
Paratoluidine	lb.	0	5	9	to	0	6	3
Phthalic anhydride	lb.	0	2	6	to	0	2	9
Resorcin, technical	lb.	0	4	0	to	0	4	3
Sulphanilic acid, crude	lb.	0	0	10	to	0	0	11
Tolidine, base	lb.	0	7	3	to	0	7	9
Tolidine, mixture	lb.	0	2	6	to	0	2	9

Essential Oils and Synthetics

Essential Oils.	£	s.	d.
Anise ..... c.i.f. 1/10½, spot weak	0	2	2
Bay ..... firm	0	11	0
Bergamot ..... weak	0	11	6
Cajuput	0	3	9
Camphor white ..... firm, per cwt.	4	2	6
Camphor brown ..... firm, per cwt.	3	18	0
Cassia ..... c.i.f. 6/9, spot easier	0	8	0
Cedarwood ..... in cases	0	1	6
Citronella (Ceylon) ..... very firm	0	2	11
Citronella (Java) ..... very firm	0	3	4½
Clove ..... firm	0	7	3
Eucalyptus ..... quiet	0	1	6
Geranium Bourbon	1	4	0
Lavender	0	12	6
Lavender spike	0	3	3
Le mon	0	2	10
Lemongrass ..... dull, per oz.	0	0	2½
Lime (distilled) ..... firm	0	2	6
Orange Sweet (Sicilian) ..... dull	0	8	6
Orange Sweet (West Indian) ..... dull	0	8	6
Palmarosa ..... firm	0	17	6
Peppermint (American)	0	13	6
Mint (dementholised Japanese) ..... weak	0	7	3
Patchouli ..... dull	1	12	0
Otto of Rose ..... dull, per oz.	1	4	0
Rosemary	0	1	8
Sandalwood ..... very firm	1	6	0
Sassafras	0	5	0
Thyme ..... according to quality, 2/6 to	0	6	0
Synthetics.			
Benzyl acetate	0	3	3
Benzyl benzoate	0	3	3
Citral	0	10	6
Coumarine	0	12	0
Heliotropine	0	5	6
Ionone	1	10	0
Linalyl acetate	1	2	6
Methyl salicylate	0	2	0
Musk xylol ..... weak	0	9	0
Terpeniol ..... firm	0	2	10

The Manchester Chemical Market

[From our own Correspondent.]

Manchester, January 25, 1923.

A quiet but steady volume of business on home trade account, and a fairly good demand for shipment are the features of the chemical market here. The overseas demand is chiefly on American account—the United States and Canada—the former, in spite of the tariff, taking good-sized parcels of several lines of chemical products. Prices are very strong, with here and there added firmness reported during the past week.

Heavy Chemicals

Caustic soda is being actively taken up, both by home consumers and for shipment, at £19 per ton for 60–68 per cent. strength, and £21 10s. for 76–77 per cent. Bleaching powder is firm and in good demand for home and export at £11 10s. per ton. Soda crystals are quieter again, though prices are firm at £5 10s. per ton delivered. Saltcake is rather more active at £4 10s. per ton. Glauber salts are also quoted at this figure, but not a great deal of business is being attracted. Sodium sulphide shows no improvement, and 60–65 per cent. concentrated is offered at £16 per ton, crystals being quoted at about £10. Bicarbonate of soda is steady at £10 10s. per ton, in 2 cwt. bags. The demand for alkali keeps up at £7 12s. 6d. per ton for 58 per cent. material. Hyposulphite of soda is still quiet, and prices are a shade weaker, photographic crystals now being quoted at about £15 10s. and commercial £9 15s. per ton. Nitrite of soda maintains the improvement reported last week, and the price is firmer at £28 per ton. Phosphate of soda is a quiet section at £15 10s. to £16 per ton. Chlorate of soda is in better demand, and price is firm at 3d. per lb. A rather dull feeling in regard to prussiate of soda is counterbalanced by short supplies, and prices are consequently well held at 9¾d. to 10d. per lb. Bichromate of soda is in moderate inquiry at 4½d. per lb. The demand for acetate of soda is still restricted, but the price is unchanged at £23 10s. per ton.

Caustic potash is steady and in rather active demand at £28 10s. per ton for 88–90 per cent. strength. Carbonate of potash maintains its recent firmness, and £31 per ton is being asked for 96–98 per cent. material. Bichromate of potash is only a quiet section at 6d. per lb. Yellow prussiate of potash is also quiet at 1s. 6d. per lb., with red at 4s. Chlorate of potash is selling fairly freely at 3½d. per lb. Permanganate of potash keeps firm at 8d. per lb.

Sulphate of copper is meeting with a better export inquiry at £26 10s. per ton. Arsenic is being taken up steadily on American account, the prices show no change, last week's quotation of £75 per ton for spot lots of white powdered, Cornish makes, being repeated. Commercial Epsom salts are a shade weaker at £5 10s. per ton, with magnesium sulphate, B.P., steady at £8 to £8 10s. Grey acetate of lime is firmer on continued scarcity at about £17 10s. per ton, with brown steady at £8 10s. Nitrate of lead is quiet, but very firm at £42 per ton. White sugar of lead is in good demand and the price is now round £40, brown being quoted at £37. Ammonium muriate, grey, is unchanged at £31 per ton. Phosphate of ammonia is in fairly good inquiry at about £60 per ton. Alum is still quiet at £12 per ton for loose lump.

Acids and Tar Products

Sellers report a much better demand for tartaric and citric acids, and both products are firmer. Tartaric is now quoted at 1s. 2½d., and citric, B.P. crystals, 1s. 8½d. per lb. Acetic acid is active, and prices are steady at £68 for glacial and £43 per ton for 80 per cent. technical. Oxalic acid is still quiet at 6½d. per lb.

Pitch is being actively sought after for export, and prices have advanced to £6 10s. to £7 per ton, f.o.b. Manchester. The demand for carbolic acids is keeping up, and crystals are firm at 8¾d. to 9d. per lb., crude 60 per cent. material still being quoted at round 2s. 6d. per gallon. Benzole is slow but unchanged at 1s. 8d. per gallon. Solvent naphtha shows little improvement, and prices if anything are easier at 1s. 8d. to 1s. 9d. per gallon. Creosote oil is a firm and active section at 7¾d. to 8d. per gallon. Naphthalenes have improved a little, and prices are maintained at last week's level.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

Glasgow, January 24, 1923.

BUSINESS continues fairly satisfactory, values on the whole being steady with no change of importance to record.

Industrial Chemicals

ACETONE.—Demand continues around £120 per ton for anything available for near delivery.

ACID, ACETIC.—Glacial, 98/100%, £60 to £64 per ton, ex wharf; 80% pure, £43 to £46 per ton, ex wharf; 80% technical, £42 to £44 per ton, ex wharf. Moderate inquiry.

ACID BORACIC.—Unchanged; crystal or granulated £55 per ton; powdered £57 per ton, delivered U.K. stations.

ACID CITRIC.—Now offered at 1s. 6d. per lb. early delivery. Spot lots, 1s. 7d. per lb.

ACID FORMIC, 80%.—Offered at £55 per ton, ex store.

ACID HYDROCHLORIC.—Makers' price unchanged, 6s. 6d. per carboy, ex works.

ACID NITRIC, 84°.—Unchanged, £27 per ton, ex station.

ACID OXALIC.—Price about 6½d. per lb. ex wharf.

ACID SULPHURIC.—Makers' prices unchanged; 144° £4 per ton; 168°, £7 5s. per ton, ex works, full loads; de-arsenicated quality, £1 per ton more.

ACID TARTARIC.—In little demand. Price 1s. 2d. per lb.

ALUM, LUMP POTASH.—Continental material about £10 10s. per ton, c.i.f. U.K. British quoted £12 per ton, f.o.b. U.K.

ALUMINA, SULPHATE.—17/18% iron free, quoted £9 10s. per ton, ex store.

AMMONIA, ANHYDROUS.—Offered at 1s. 6d. per lb. ex station.

AMMONIA CARBONATE.—Lump, 4d. per lb.; ground, 4¼d. per lb. delivered.

AMMONIA LIQUID.—880°. 3½d. per lb.; 920° 1¾d. per lb. ex works.

AMMONIA MURIATE.—Grey galvanisers quality about £31 per ton; fine white crystals £27 10s. ex store.

AMMONIA SULPHATE.—25¼% £15 5s. per ton; 25¾% neutral, £16 8s. per ton, ex works. January/February delivery.

ARSENIC, WHITE POWDERED.—Price about £73 per ton, ex quay.

BARIUM CHLORIDE 98/100%.—Offered from Continent at £16 per ton, c.i.f. U.K.

BARYTES.—Finest white English make, £5 5s. per ton, ex works.

BLEACHING POWDER.—Spot lots, £11 10s. per ton, ex station.

BORAX.—Unchanged; crystal or granulated, £28 per ton; powdered, £29 per ton, carriage paid U.K. stations.

CALCIUM CHLORIDE.—English material, £5 15s. per ton, ex quay or station. Continental make, £4 10s., ex store.

COPPER SULPHATE.—Moderate export inquiry. Now offered at £26 10s. per ton, f.o.b. U.K.

COPPERAS, GREEN.—Price about £3 15s. per ton, ex works.

DEXTRINE.—Finest Dutch potato, quoted £20 per ton, c.i.f. U.K.

FORMALDEHYDE 40%.—Spot lots about £91 per ton, ex store. Offered for forward delivery at £89 per ton, c.i.f.

GLAUBER SALTS.—Fine white crystals offered for forward delivery at £2 17s. 6d. per ton, c.i.f. U.K.

LEAD.—Red, £39 15s. per ton; white, £51 10s. per ton, delivered U.K. 5-ton lots. Continental red lead now £35 per ton, ex store.

LEAD ACETATE.—White crystals offered at £37 per ton, c.i.f. U.K. Brown, about £34 per ton, ex store.

MAGNESITE.—In little demand. Quoted £7 to £10 per ton, ex store.

MAGNESIUM CHLORIDE.—Spot material, £3 17s. 6d. per ton, ex store. Offered from Continent at £2 19s. 6d. per ton, c.i.f.

POTASSIUM BICHROMATE.—Price unchanged at 6d. per lb. delivered.

POTASSIUM CARBONATE, 90/92%.—Spot lots, £27 per ton, ex store. Offered from Continent at £25 per ton, c.i.f. U.K.

POTASSIUM CAUSTIC, 88/92%.—Offered at £29 per ton, ex store, spot delivery.

POTASSIUM CHLORATE (98/100% powder).—Offered from Continent at £24 per ton, c.i.f. U.K.

POTASSIUM NITRATE (Saltpetre).—Quoted £26 per ton, c.i.f. U.K.

POTASSIUM PERMANGANATE.—B.P. quality quoted 8d. per lb., ex store.

POTASSIUM PRUSSIATE, YELLOW.—Unchanged at 1s. 6d. per lb. ex station.

POTASSIUM SULPHATE.—Price about £15 per ton, f.o.b. U.K. port, basis 90%.

SODIUM ACETATE.—Moderate inquiry. Offered at £24 per ton, ex store.

SODIUM BICABONATE.—Refined recrystallised quality, £10 10s. per ton, ex quay or station; m.w. quality, 30s. per ton less.

SODIUM BICHROMATE.—English makers quote 4½d. per lb. delivered.

SODIUM CARBONATE.—Soda crystals, £5 5s. to £5 10s. per ton, ex quay or station; alkali, 58%, £8 17s. 6d. per ton, ex quay or station.

SODIUM CAUSTIC.—76/77%, £21 10s. per ton; 70/72%, £20 per ton; 60/62%, broken, £21 5s. per ton; 98/99%, powdered, £24 17s. 6d. per ton, ex station, minimum 4-ton lots.

SODIUM CHLORATE.—Offered at 3d. per lb., ex station.

SODIUM HYPOSULPHITE.—Commercial crystals, £10 10s. per ton, ex station; pea crystals about £16 per ton, ex station.

SODIUM NITRATE, 96/98%.—Offered at £13 per ton, f.o.r.

SODIUM PRUSSIATE, YELLOW.—Price about 10¾d. per lb. ex store.

SODIUM SULPHATE (Saltcake 95%).—Price to home consumers unchanged, £4 per ton, on contract. Higher prices for export.

SODIUM SULPHIDE.—60/62% conc. offered from Continent at £13 10s. per ton, c.i.f. U.K.; 30/32% crystals, £7 5s. per ton, c.i.f. U.K.

SULPHUR.—Government surplus stocks of Sicilian thirds available at £3 10s. to £3 15s. per ton, ex depot. Flowers £10 per ton; roll £9 per ton; rock £8 per ton; ground £8 per ton, ex store.

TIN CRYSTALS.—Unchanged at 1s. 2d. per lb.

ZINC CHLORIDE.—98/100% solid offered from Continent at £22 per ton, c.i.f. U.K.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

Coal Tar Intermediates and Wood Distillation Products

BETA NAPHTHOL.—In good demand. Price still 1s. per lb., packages free.

DINITROCHLORBENZOL.—Supplies are offered at £95 per ton, f.o.b. English port, packages free.

DIETHYLANILINE.—Export inquiry. Offered at 4s. 7d. per lb., f.o.b. U.K., port, drums included.

"H" ACID.—Several inquiries; price 5s. 1d. per lb. 100 per cent. basis delivered, packages free.

MONO NITROCHLORBENZOL.—Export inquiry, price quoted, £100 per ton, delivered f.o.b. U.K. port packages included.

MONONITROTOLUENE (CRUDE).—Small inquiry. Offered at 1s. per lb., carriage paid, packages extra.

METHYL ALCOHOL (PURE).—Offered at £104 10s. per ton, c.i.f. U.K. port.

NITRO NAPHTHALENE.—Small inquiry, price quoted 1s. per lb., packages inclusive, carriage paid.

PARADICHLORBENZOL.—Small inquiry; price £50 per ton, f.o.b. U.K. port.

SCHAEFFER SALT.—Small lots offered at 6s. per lb., 100 per cent. basis, paste form; packages extra.

Company News

INTERNATIONAL NICKEL CO.—A quarterly dividend of 1¼ per cent. on the preferred shares is payable on February 1 to holders of record, January 18.

ANACONDA COPPER MINING CO.—Cabled advice has been received at the London office of the National City Co. to the effect that the issue of $50,000,000 7 per cent. debentures has been oversubscribed.

DAY AND MARTIN, LTD.—At an extraordinary general meeting held on January 18 to discuss the future of the business an advisory committee was appointed to consider the position and to report to an adjourned meeting to be held at Cannon Street Hotel, London, on February 8, at 3 p.m.

LASTENIA NITRATE CO., LTD.—Fully paid letters of acceptance or scrip certificates in respect of the company's recent issue of capital may now be lodged for registration at Lloyds Bank, 72, Lombard Street, London. Scrip certificates to bearer will not be issued against letters of acceptance after February 28.

BRITISH BROKEN HILL PROPRIETARY CO., LTD.—Acceptances representing nearly 93 per cent. of the total issued capital of the company have been received in response to the offer recently made by Messrs. E. L. and C. Baillieu, of Melbourne. The offer accordingly becomes effective and the necessary details in connection therewith are being carried into effect.

CHAMPION AND SLEE, LTD.—Presiding on Monday at the annual meeting of the company, Mr. Herbert H. Slee said the directors proposed to transfer from reserve account a sum sufficient completely to expunge the adverse balance carried to the balance sheet, and also to cover the amount required to pay the cumulative preference share dividend. The directors regretted the necessity of passing the ordinary dividend this year.

BREWERS' SUGAR CO.—The accounts for the 15 months to December 31 last, including £9,997 brought forward, and after providing for preference dividend, show a disposable balance of £47,494. The directors recommend a dividend for the period of 20s. per share, free of tax, placing £2,500 to general reserve, and £5,000 to reserve for equalisation of dividends, carrying forward £10,994, subject to directors' remuneration. The whole of the 5 per cent. preference capital was repaid on September 30 last.

LEVER BROTHERS, LTD.—A circular issued to shareholders states that a general meeting will be held at Port Sunlight on January 30, for the purpose of considering and, if thought fit, passing resolutions for converting the 5 per cent. cumulative preferred ordinary shares of the company into 8 per cent. cumulative preferred ordinary shares, and for making consequential alterations in the articles of association. These proposals do not in any way affect the rights of the holders of the 7 per cent. preference shares, the 8 per cent. "A" preference shares, or the three classes of 20 per cent. cumulative preferred ordinary shares of the company.

NEW TAMARUGAL NITRATE CO., LTD.—A gross profit of £69,535 is shown in the accounts for the year ended July 31. After deducting London expenses, £4,857; reserve for income. tax, £2,000; stoppage expenses, £11,576; and redemption of, and interest on debentures, £19,160, there remains a balance of profit of £31,942. The sum of £75,198 brought forward brings the total up to £107,140. The year's interest on the income bonds absorbs £2,983, and the amortisation of income bonds account (5 per cent. of total issue) required £6,215. It is proposed to pay a further dividend of 10 per cent. (2s. per share) making 15 per cent. for the year, and £56,999 is carried forward. Profit has been taken on 378,804 (against 594,000) Spanish quintals of nitrate sold. A drawing of income bonds to the value of £12,430 was made on Monday. There was a net profit for the previous year of £139,441, and the dividend was the same.

Soapworks Dispute Settled

IT is officially stated that, as a result of negotiations between the chairman of the Soap and Candle Trade Employers' Federation, representatives of J. C. and J. Field, Ltd., and Mr. Boyd, of the National Union of Distributive and Allied Workers, a settlement has been reached in the dispute between Messrs. Field and their employees at the Lambeth Soapworks. The men resumed work on January 19.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

LOCALITY OF FIRM OR AGENT.	MATERIAL.	REF. No.
Amsterdam....	Formaldehyde, caustic soda, Epsom salts, sulphate of soda, soda crystals, tartaric acid, chloride of ammonia, etc. ...	96
The Hague	Caustic soda.....	96

"Chemical Age" Inquiry List

The following inquiries have been received from readers of "The Chemical Age." Replies addressed to the box number given below, c/o "The Chemical Age," 8, Bouverie Street, London, E.C.4, will be forwarded to the inquirers.

Lime-slaking machine, maximum capacity 80 tons per hour.—No. H1.

Anthracene, bone grease, naphthalene.—No. H2.

Lead spraying apparatus.—No. H3.

Brazilian agency wanted for industrial chemicals.—No. H4.

"Unemployed"

To the Editor of THE CHEMICAL AGE.

SIR,—I noted your Leader in THE CHEMICAL AGE this week, regarding employment of Chemists. Owing to the operation of the "Geddes Axe" I have been out since July and have been almost eating my head off since. Cannot you give me a suitable introduction? The enclosed copy of my record indicates my very varied experiences. I could fit in almost anywhere.—Yours, etc.,

H. A.

[We shall be glad to pass on to our correspondent any inquiries. The qualifications seem excellent.—ED. *C.A.*]

Colours and Chemicals: a new Firm

MR. ERNEST G. SAWYER, late manager of the Central Importing Agency for reparation dyestuffs has issued the following circular:—

E. G. SAWYER & Co.
(E. G. Sawyer),
Colours and Chemicals.
"Dominion House," 110, Fenchurch Street, E.C.3.
January 22, 1923.

Dear Sirs,—Kindly note that I have resigned my position from the Board of Messrs. Fairclough, Dodd & Jones, Ltd., London, and also as Director of The Aniline Storage Co., Ltd., of Trafford Park. From to-day I am starting my own firm, trading as Messrs. E. G. Sawyer & Co., address as above. Trusting that you will continue to give me the support you have in the past and assuring you of my personal attention to your requirements, I remain, yours faithfully,

ERNEST G. SAWYER,
Late manager of the Central Importing Agency
(Board of Trade).

Indian Indigo Crop for 1922-23

A FINAL memorandum on the indigo crop of 1922–23, based upon reports received from provinces containing practically the whole area under indigo in British India, states that the total area is estimated at 296,800 acres, which is 7 per cent. below the finally revised area of the previous year. The total yield of dye is estimated at 54,600 cwt. as against 61,600 cwt., or a decrease of 11 per cent. A statement of the yield per acre by provinces shows that Madras, with 25 lb. per acre gave the highest yield. The yields for the other provinces were:—Punjab, 21 lb.; Bombay and Sind (including Indian States), 19 lb.; Bihar and Orissa, 13 lb.; United Provinces, 12 lb.; and Bengal, The 3 lb. figures refer to the crop which is now being marketed.

THE BRITISH ALIZARINE COMPANY LTD.

Manchester London Glasgow

Manufacturers of Alizarine Dyestuffs

ALIZARINE RED (all shades)

ALIZARINE BLUES (soluble and insoluble)

ALIZARINE BORDEAUX

ALIZARINE CYANINE

ALIZARINE GREEN (soluble and insoluble)

ALIZARINE ORANGE

ALIZARINE RED S. POWDER

ALIZARINE BLUE BLACK

ALIZARINE (MADDER) LAKES (of all qualities)

ALIZARINE MAROON

ALIZUROL GREEN (Viridine)

ANTHRACENE BROWN

ALIZANTHRENE BLUE

ALIZANTHRENE BROWN

ALIZANTHRENE YELLOW

Other fast colours of this series in course of preparation

Anthraquinone, Silver Salt and all intermediates of this series

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CHROME TANNING and other Chrome Compounds

TELEPHONES
663 Trafford Park, MANCHESTER
668 EAST LONDON
3667 DOUGLAS, GLASGOW

TELEGRAMS:
BRITALIZ MANCHESTER
BRITALIZ LONDON
BRITALIZ GLASGOW

All communications should be addressed to

The British Alizarine Co., Ltd.
Trafford Park, Manchester

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

County Court Judgments

[*NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.*]

ALLKINS, Mr. W. H., 1, Exchange Buildings, Brighton Road, chemist, Coulsdon. (C.C., 27/1/23.) £15 10s. 3d. December 4.

BISSELL, Mr. S. S. J., 65, Church Lane, Wolverhampton, manufacturing chemist. (C.C., 27/1/23.) £21 11s. 2d. December 7.

DEBONAIRES' DRUG STORES, 160, Wood Street, Walthamstow, chemists. (C.C., 27/1/23.) £10 5s. 9d. December 11.

HAIGH, Mr. H. S., 19, Holton Road, Barry Dock, chemist. (C.C., 27/1/23.) £16 14s. 4d. December 5.

ROYAL DYERS, 55, Burlington Street, Manchester, dyers. (C.C., 27/1/23.) £14 17s. 3d. December 2.

WESSON, Mrs. M. J. E. (wife of — Wesson), 10, Dronfield Street, Leicester, druggist. (C.C., 27/1/23.) £10 6s. 4d. November 29.

Receivership

LONDON PHARMACEUTICAL REFINERS, LTD. (R., 27/1/23.)—C. J. Gladwell, of 19, Garrick Street, W.C. (2) ceased to act as receiver or manager on January 8, 1923.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALLAN (K. L.) AND CO., LTD., Liverpool, manufacturers of greases, etc. (M., 27/1/23.) Registered January 9, 1st debenture; general charge. *Nil. January 3, 1922.

AYRTON SAUNDERS AND CO., LTD. (late AYRTON SAUNDERS AND KEMP, LTD.), Liverpool, druggists. (M., 27/1/23.) Registered January 12. £40,000 mortgage to Assurance Co.; charged on 32, 34 and 36, Hanover Street, Liverpool. *£41,300. July 14, 1922.

DEARBORN (1923), LTD., London, W.C., manufacturing chemists. (M., 27/1/23.) Registered January 10. £53,644 10s. 4d. debenture, to J. Van T. Daniels, 30, North La Selle Street, Chicago, U.S.A.; general charge.

IDEAL CLEANERS AND DYERS, LTD., London, W. (M., 27/1/23.) Registered January 12, debenture to Bank; charged on property at Northfield Road and Northfield Avenue, Ealing, etc.; also general charge. *——. July 31, 1922.

LONDON LUBRICANTS (1920), LTD., London, E. (M., 27/1/23.) Registered January 12, £935 mortgage and Land Registry charge, to House Property and Investment Co., Ltd., 4, Queen Street Place, E.C.; charged on 4 to 22 (even), Monier Road, Poplar. *£10,000. September 9, 1921.

PRECIOUS (HAROLD), LTD., Bradford, dyers. (M., 27/1/23.) Registered January 8, mortgage securing £1,020 and further advances, to Halifax Permanent Building Society; charged on 4, 6, 8, 10, 12, Vaughan Street, Westgate, Bradford. *Nil. May 12, 1921.

VAN DUZER (S. R.) AND SON, LTD., London, W.C., wholesale chemists. (M., 27/1/23.) Registered January 10. £10,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £5,500; general charge.

Satisfactions

AYRTON SAUNDERS AND CO., LTD. (late AYRTON SAUNDERS AND KEMP, LTD.), Liverpool, druggists. (M.S., 27/1/23.) Satisfaction registered January 12, £12,500, registered June 24, 1912.

IDEAL CLEANERS AND DYERS, LTD., London, W. (M.S., 27/1/23.) Satisfaction registered January 12, all moneys, etc., registered March 2, 1922.

OLD SILKSTONE CHEMICAL WORKS, LTD., Cleckheaton. (M.S., 27/1/23.) Satisfaction registered January 16, £19,500, registered November 7, 1912.

London Gazette

Companies Winding Up

ROUMANIAN OIL TRADING CO., LTD. (C.W.U., 27/1/23.) Last day for receiving proofs, February 8. Liquidator, H. E. Burgess, Senior Official Receiver and Liquidator, 33, Carey Street, Lincoln's Inn, London, W.C.2.

SPRING VALE DYE WORKS (THE), LTD. (C.W.U., 27/1/23.) Last day for receiving proofs, February 3. Liquidator, F. Murgatroyd, Palatine Chambers, Silver Street, Bury.

Companies Winding Up Voluntarily

ESSEX CHEMICAL CO. (THE), LTD. (C.W.U.V., 27/1/23.)—C. B. Stott, 27, Farm Street, W., and H. W. Rymer, Wakering Road, Barking, appointed joint liquidators.

PARKER AND LESTER, LTD. (C.W.U.V., 27/1/23.)—R. E. Smith, F.C.A., 79, Mark Lane, London, E.C., appointed liquidator.

ROCHESTER OIL CO., LTD.—Meeting of creditors at 1, Mitre Court Buildings, London, at 12 noon, on Wednesday, January 31.

Notices of Intended Dividends

DODD, Richard Jefferson, 70, Tottenham Court Road, and 146, Edgware Road, W., 35, Hampstead Road, N.W., 123, Judd Street, W.C., 121, Euston Road, N.W., 310, Gray's Inn Road, chemist and druggist. Last day for receiving proofs, Tuesday, January 30. Trustee, W. Boyle, Senior Official Receiver, Bankruptcy Buildings, Carey Street, London, W.C.2.

VAN WAASDYK, Victor Gerard, lately carrying on business as NAGELS AND CO., 51, Fenchurch Street, E.C., chemical merchant. Last day for receiving proofs, February 8. Trustee, F. T. Garton, Official Receiver, Bankruptcy Buildings, Carey Street, London, W.C.2.

Notice of Dividend

SEDDON, Percy, 32, Rochdale Road East, and 30, Bridge Street, both in Heywood, in the county of Lancaster, chemist. Amount per £, 1s. 10¾d. First and final. Payable January 23, Offices of the Trustee, Arthur Tyldesley Eaves, 15, Fountain Street, Manchester.

Partnership Dissolved

DRAUGHTSMAN SPECIALITY CO. (Charles Geoffrey RIDDELL and Claude Wallace Hamilton FLETCHER), manufacturers of the Draughtsman Deodorising Tank Disinfectant and Indigestion Cure, Walter House, 52, Bedford Street, Strand, London, by mutual consent as from October 19, 1922. Debts received and paid by C. G. Riddell.

New Companies Registered

J. BARTON-FAITHFULL, LTD., White lead, colour, varnish, printing-ink manufacturers; drysalters, etc. Nominal capital, £2,000 in £1 shares. A subscriber: H. G. Read, 80, Christchurch Road, Southend-on-Sea.

CLENSALL SOAP CO., LTD. Manufacturers of soaps, perfumes, chemicals, essential oils, etc. Nominal capital, £1,000 in £1 shares. Solicitors: H. E. Warner and Co., 1, Great Winchester Street, London, E.C.

DEARBORN (1923), LTD., 37, Gray's Inn Road, W.C. Manufacturing and wholesale chemists and druggists, drysalters, etc. Nominal capital, £6,000 in £1 shares.